METAL INDUSTRY

7 MARCH 1958

Research on Tin

EVEN a cursory glance at the recently published Annual Report of the International Tin Research Council is sufficient to give an idea of the many fields in which work is being carried out with the ultimate object of increasing the sales of tin. Closer study reveals that during 1957 the Tin Research Institute was responsible for no less than 48 new publications, of which the total number of copies distributed was in excess of 150,000. A notable achievement was the publication of a method of producing electroplated deposits of tin in a fully bright form. The tin deposit obtainable by electroplating has hitherto been matte and chalky in appearance and the new method produces coatings which come from the bath with the appearance of having been mechanically polished. Essentially, the process, which is available without patent restrictions of any kind, requires the addition of a dispersion of wood tar prepared with a selected surface-active agent to an acid stannous sulphate electrolyte. Tests of tin-nickel alloy deposits show that for indoor environments of comparatively mild corrosivity an undercoating is not necessary, and coatings up to 0·0005 in. thick, depending on the environment, give excellent protection. For out-of-doors use, undercoatings of copper or bronze, preferably polished after plating, are desirable, but no advantage accrues from increase of undercoating thickness above 0·0005 in. It is interesting to note that this alloy plate has been adopted by instrument makers when particularly hard-wearing and corrosion-resistant finishes are required.

In another field the Institute's invention of a method of bonding aluminium-tin bearing alloys to steel has now reached the commercial stage of development, and, in Italy, thousands of cars have already been fitted with the new type of bearings. Work has also been carried out on the continuous casting of solder billets for extrusion. The solder is cast into a vertical cylindrical metal mould and withdrawn in a practically solidified state from the bottom of the mould through powerful water sprays. The principle of casting thus differs from that used in the T.R.I. machine for continuously casting bronze where the metal is completely solidified while being drawn through a graphite die. No difficulty has been encountered in casting solder billets 2½ in. in diameter up to 7 ft. in length, but it is not yet clear whether the billets are free from the segregation which often affects chill-cast extrusion billets.

Another process developed by the Institute which has attracted much interest in industry on account of its simplicity when compared with other procedures is the "direct chloride" process for tinning cast iron. In this process iron castings after blasting with fine steel grit are dipped in molten tin through a ternary flux layer of special composition. The process has proved of considerable assistance in connection with the tinning of cast-iron bearing shells prior to lining with Babbitt alloys. Investigations have also been carried out on the production of titanium-tin and titanium-tin-aluminium alloys by the powder metallurgy method, the same method being used to extrude finely powdered tin through a die to give a rod stronger than cast tin. Since the extra strength is believed to be associated with the presence of films of oxide around the unpressed tin powder, a study has been made of the effects on the properties of extruded rods of the addition of small refractory particles mechanically mixed with the tin powder before extrusion.

Sufficient has been said to indicate that all departments were actively engaged in pursuing new ideas and developing fresh applications of tin. Similar activity is going on in the aluminium and plastics industries. What is the copper industry doing?

Out of the MELTING POT

Four-Round THE mechanics of the metal sheet and strip rolling process have, as is well known, resulted in a trend towards rolls of smaller and smaller diameter, with a view to increasing the reduction in thickness achievable per pass. The mechanics of the rolls, combined with the above trend, brought about the necessity of providing suitable support for small-diameter rolls, leading to mills with more and more rolls—a development that culminated in the cluster type of mill—or to other arrangements for supporting thin working rolls, such as, for example, the planetary mill. A novel approach to the problem of supporting a working roll of relatively small diameter has been made in the recently-described centreless rolling mill. This mill is intended for the rolling of foil strip of 0·001 to 0·005 in. thickness, and permits a sensitive and accurate adjustment of the rolls. In its simplest form the mill comprises a pair of side frames, in each of which is mounted a ring capable of rotation in its frame. Each ring carries three roll bearings, disposed at 120° to each other. These bearings are provided with "hold down" screws, by means of which their position can be adjusted in a radial direction relative to the rings on which they are mounted. The bearings carry three rolls of relatively large diameter. These rolls support between them a small-diameter centreless working roll. The working roll is driven directly by an electric motor, while the supporting rolls are driven by belts running between pulleys mounted on stub axles of the working and supporting rolls. In the simplest arrangement, the strip to be rolled passes between the working roll and one of the supporting rolls, but a method of working in which the strip is given two passes during one passage through the mill, i.e. between the working roll and one supporting roll, and then between the working roll and a second supporting roll, is also possible. An interesting feature of the mill is that by arranging the surfaces of contact between the ends of the screws and the roll bearings to be inclined to the axes of the screws, the positions of the rolls can be adjusted simultaneously by rotating the rings on which they are mounted.

Surfeit CONTROLLING or at least influencing all the process variables is an excellent thing in theory, but may often amount to a counsel of unnecessary perfection in practice. This is particularly the case where the effects of the process variables are all of roughly equal importance with no one variable exerting a decisive effect, and where, moreover, the effects of such variables have a considerable degree of overlap. A situation of this kind is to be found, for example, in the conventional continuous casting process using a vertical open-ended water-cooled die. Most of the variables are familiar, though research on the process has not yet freed it completely from obscure, little-understood, but fortunately, only minor phenomena. Numerous attempts have, however, been made to conform to theory and obtain control of all the known variables of the continuous casting process. These attempts include the die itself, with a finely ribbed interior surface, with various devices for improving heat transfer and increasing the cooling efficiency of the circulated water, and with arrangements to vibrate the die and make it perform various up-and-down reciprocating motions. The arrangements for pouring the metal into the die defy imagination. Once in the die, the molten metal would be subjected to ultrasonic vibrations, rotating electromagnetic fields and such-like influences, in addition to being made to operate a number of thermal, mechanical and electronic devices intended to provide control in terms of temperature, liquid metal level position, etc. Finally, there would be a most complex arrangement for spraying the cast product with cooling liquid as it emerges from the die, with provision for controlling the distribution and intensity of the spray. All this could result in a near-perfect cast product having most desirable surface characteristics, grain size and orientation, and substantial freedom from cracks and internal stresses. How much of all this would be an unnecessary luxury, and how much would be necessitated by the neglect of the purer metallurgical factors—alloy composition, grain refining agents, etc.?

Supersonic SPEED of cutting in machining operations is usually considered from the point of view of the rate of output. Assuming the machine tool is powerful enough to produce it, and the cutting tool is strong enough to stand it without excessive wear, the higher the cutting speed, the better. Hitherto, the limits of available power and of increasingly uneconomically large rate of tool wear have been reached more or less simultaneously. The few indications that, as cutting speed continues to increase, tool wear appears to get worse and worse before starting to get better, have not been followed up because of the limits set by available machine tool speeds. These limits have now been exceeded, and the indications of tool life improving with cutting speed after passing through a minimum at a critical speed have been confirmed. A rush towards the use of very much higher cutting speeds in practice must, unfortunately, be forestalled by explaining that the cutting speeds used in this exploratory work carried out by the Lockheed Aircraft Corporation, were attained by using not a machine tool but a rifle. The barrel of the rifle was smooth-bored to take a 0·300 in. diameter 2 in. long slug of the metal to be machined, which, in the case of these tests, was AISI 4130 steel heat-treated to 280,000 lb/in^2 tensile strength. The cutting tool was mounted in a holder on the muzzle end of the rifle. Tools of 90° included angle, and flat-nose tools of various tool steels and carbides, were used, and the slugs fired past them at speeds equivalent to 132,000 to 162,000 surface ft/min. Only one tool failure occurred. The cuts were smooth (20 microinch finishes with the flat nose tool) and with only a slight increase in hardness to a depth of 0·010 in. below the machined surface. A curious feature of this supersonic machining technique is that no chips have so far been found. Once experiments along these lines will have established critical machining speeds for different metals, it is suggested that it will be up to the machine tools builders to produce equipment with the necessary speed and rigidity.

Skimmer

REVIEW OF PROGRESS IN ARC, INDUCTION AND RESISTOR FURNACES

Electric Furnace Developments

By P. F. HANCOCK, B.A., F.I.M.

(*Concluded from* METAL INDUSTRY, 28 *February*, 1958)

IN considering developments in induction heaters, it is not intended to give attention to such applications as surface hardening, local heating, or brazing, which have been very fully described elsewhere, but rather to concentrate on the larger scale bulk heating uses, particularly the heating of bars, billets, blooms and slabs for hot working.

Advances here in recent years have been connected, as in the case of induction melting, with the development and increasing use of units operating at mains frequency (50 or 60 cycles/sec.). The reasons for the late arrival of mains frequency induction heaters are to some extent similar to those affecting the coreless induction melting furnace, with, perhaps, greater emphasis on the minimum size factor. For solid bar, or sections, these minima for different metals are approximately as follows:—

Steel (magnetic state) ..	1 in.
Steel (non-magnetic state)	6 in.
Copper and Copper-base alloys	3-4 in.
Aluminium alloys	3-4 in.

Below these sizes, efficiency of heating at 50 cycles/sec. falls to unacceptably low levels. The method is, therefore, confined to fairly large-scale operation, for which electric heating would not have been seriously considered until comparatively recently.

The difference in minimum section for ferrous alloys in the magnetic and non-magnetic states should be especially noted, since this permits an approach to the heating of steel sections intermediate in size between these limits, i.e. 1 in.-6 in., which shows some advantage over simple high-frequency heaters. The technique is to preheat the billet up to the region of magnetic change, say 600-650°C., in one coil powered at 50 cycles/sec., and then transfer it to a second coil powered at a suitable higher frequency, say 1,000 cycles/sec., for final heating to the working temperature of 1,200-1,250°C. By these means, the size, power and cost of the high-frequency generator equipment required is roughly halved, with a notable corresponding reduction in the total capital cost of the installation.

In the case of a continuous billet heater of the usual pusher type, the 50 cycles/sec. and high-frequency coils are placed in line, the billets passing successively through them, and the coil lengths being adjusted so that transfer from the one to the other takes place when the billets have reached the appropriate temperature. An example of a "dual frequency" heater of this kind, rated at 400 kW total, is illustrated in Fig. 5. It is employed for forging billets of 3 in. and 4 in. section, and has a nominal production of 1 ton/hr.

As already indicated, the minimum steel section which can be efficiently heated to full temperature at mains frequency is about 6 in. No installations of this kind are yet in operation in this country. Various projects for the heating of blooms, slabs and ingots are, however, under consideration, with power ratings ranging from 2,000 kW upwards, some of which will, doubtless, be implemented within the next few years.

In the non-ferrous field, numerous installations are now in operation for the heating of aluminium alloy extrusion billets, mostly ranging in power between 150 and 1,000 kW, and this application can be regarded as well-established, at any rate for certain classes of alloy. There is one unit of 300 kW in operation for heating pure aluminium slabs for rolling (Fig. 6). A similar 400-450 kW unit for heating high-strength light alloy slabs for rolling will come into operation very shortly. The latter will be on an experimental basis, since the permissibility or otherwise of rapid heating, without soaking or homogenizing, for various categories of light alloys is still an undecided question. Additionally, there are several installations for heating of copper, brass, and cupro-nickel extrusion billets, and consideration is being given to the heating of copper wire-bars by this method.

The potential advantages of induction heaters, as compared with conventional reheating furnaces of either fuel-fired or electric resistor type, lie in the small floor space they occupy, and in the ability to start up and shut down at short notice, so eliminating stand-by heat losses and improving overall efficiency. In the case of steel forging billets, the reduced amount of scale, resulting from quick heating, is an additional advantage.

Their present state of development is such that they can appropriately be considered for applications such as have been described, but there is still much scope remaining for their improvement and refinement.

For example, the problem of temperature control cannot yet be said to have been solved in a satisfactory manner, particularly for steel and other alloys requiring high temperatures. Since, in an induction heater, only the workpieces come to full temperature, the main problem of control resolves itself into one of accurate measurement of the workpiece temperature. For aluminium alloys, the

Fig. 5—Dual frequency 400 kW 3 kilocycles/sec induction billet heater

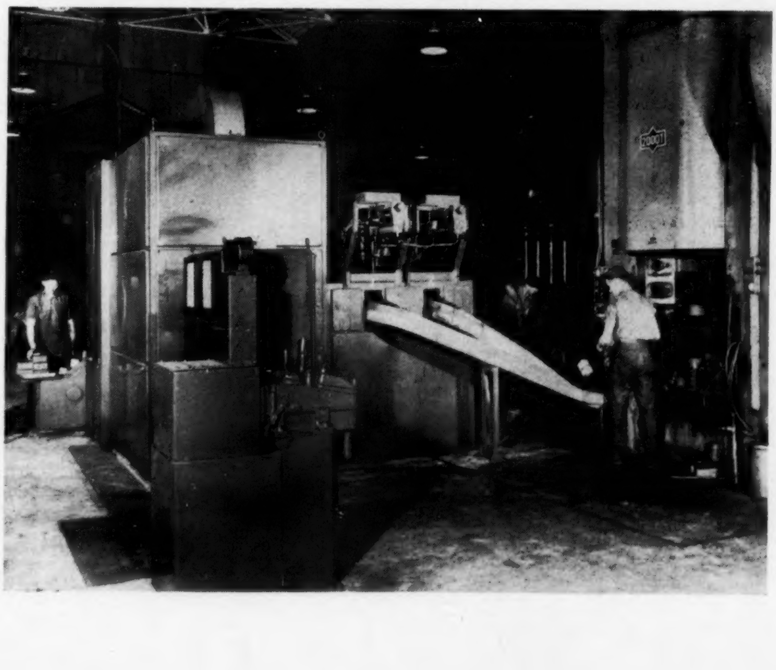


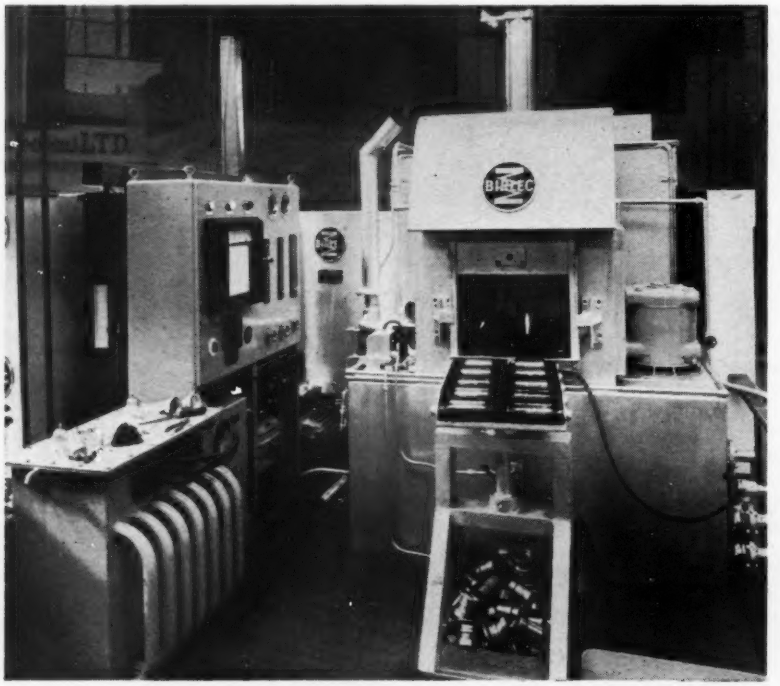
Fig. 6—Induction-heated aluminium slab heater, 300 kW 50 cycles/sec

"two-prong" thermocouple gives acceptable results, but, requiring as it does good electrical as well as thermal contact, it is unsatisfactory on alloys which form scale at the required top temperature, e.g. copper-base alloys. For the latter, a "single-prong" thermocouple, i.e. one having a normal welded junction—which thus requires only good thermal contact—suitably shaped to press firmly against the workpiece surface, gives reproducible, if not absolutely accurate, measurement. For steel, and other alloys requiring temperatures of the order of 1,150-1,250°C., only radiation pyrometers appear potentially suitable. But no solution has yet been forthcoming for eliminating the inaccuracy occasioned by loose scale on the steel surface.

Another problem relates to the operation of such heaters under stand-by conditions. Taking the case of extrusion, plainly the heater should be capable of delivering a heated billet whenever the press is ready to accept it, regardless of occasional delays for changing of tools, clearance of "stickers" or the like. But with the usual form of continuous pusher type heater, in which a row of billets is progressed through a coil having uniform power distribution and simple on-off temperature control actuated in response to the temperature of the end billet, this is not always achieved. When the delivery of billets is stopped and the row of billets remains stationary in the coil, the normal temperature distribution along the length is upset and, on resuming operation, regular delivery of billets at the correct temperature may not be obtained. One suggested solution[1] is to grade the power input along the length of the coil under stand-by conditions in approximate relation to the rate of heat loss from each billet, so as to maintain the normal temperature distribution, at any rate for a limited period.

These are some of the problems which will, no doubt, be solved as development of induction heaters proceeds. There are also interesting possibilities of producing special heating effects, obtainable only by the induction method, such as the "taper heating" of extrusion billets[2] recently proposed.

Fig. 7—"Electric radiant tube" heated sealed quench furnace, 30 kW rating



Resistor Furnaces

This, the largest category of electric furnaces, in terms both of number of types and of total installed capacity, is, perhaps, the most difficult to deal with from the aspect of recent development. There have, without doubt, been many improvements effected in design of heat-treatment furnaces, and many new processes and applications, but most of these have been related to general construction and methods of work-handling and not associated particularly with the mode of heating. It is, indeed, difficult to pinpoint more than a few recent advances in technique in which electric heating as such has been the decisive factor.

Another class of heat-treatment, in which great developments have been made, includes gas carburizing, carbonitriding, and related processes in which atmospheres of controlled carbon potential are employed. Where such atmospheres contain significant amounts of hydrocarbon gases, exposed electric elements of the conventional types are generally unsatisfactory, on account of carbon deposition rendering the refractories electrically conducting and so causing short circuits. As a result, gas-fired radiant tubes were commonly used for heating furnaces used for these processes, except in the smaller batch type units, in which the work chamber could conveniently be formed by a metallic retort or muffle. To enable

electric heating to be employed on the larger furnaces, a new type of element, usually called an "electric radiant tube," has been developed. This has a spiral element, wound from heavy wire or rod, on a refractory former, this assembly being removably mounted inside an outer gas-tight metallic sheath, which isolates it from the atmosphere. A batch-type furnace with enclosed quench for gas-carburizing and carbonitriding processes, heated by this type of element, is illustrated in Fig. 7. An alternative approach to the same problem is to use a very heavy element, fabricated from sheet and operated at a voltage so low that carbon deposition on the refractories does not affect its performance.

Furnaces for high temperatures, particularly when controlled atmospheres are required, are nearly always electrically heated, and there have been some notable improvements in heating elements. Modified varieties of the conventional resistor alloys, of both nickel-chromium and chromium-aluminium-iron varieties, have been introduced capable of operating at higher temperatures and giving better resistance to corrosive attack. There are also improved forms of silicon carbide element. A completely new element material, usable up to temperatures of about 1,700°C., has been recently developed, made from molybdenum disilicide with a metallic bond. Fabricated by powder metallurgy methods, the forms in which this material is so far available are somewhat limited, and as yet suitable only for small furnaces.

Another quite new development is the use of an electrically-heated fluidized powder bed for heat-treatment purposes. Fluidized beds have good heat transfer properties and there are interesting possibilities here. The development is, however, still in the early stages, and practical applications have not yet been worked out.

In dealing with this very large subject, there have, of necessity, been many omissions. For example, nothing has been said of submerged arc-smelting furnaces, electric furnaces for glass melting, and many other special types. An even larger omission is of all reference to vacuum furnaces, but the latter was felt to be too specialized a subject for inclusion in a general review. However, enough has, perhaps, been said to give an indication of the present scope and future possibilities of electric furnaces.

References

[1] Brit. Pat. Application No. 7367/56.
[2] A. J. Mueller; *Metal Progress*, 1957, 72 (2), Feb.

Forming and Welding Titanium

SURVEYING current uses of titanium in the aircraft industry, a Paper dealing with manufacturing practice, which was presented at a conference organized by the Institution of Production Engineers, refers to the hot forming of titanium by The English Electric Co. Ltd., who use a rubber die press with a silicone rubber insulating blanket to protect the rubber bolster in the press. Titanium parts and form blocks are heated to around 300°C. in an electric oven adjacent to the press table. The form blocks are made in steel.

For the welding of titanium, the Paper refers to an argon atmosphere. An argon arc torch is used to protect the weld pool, and the component is mounted on a welding fixture with a groove at the back of the weld so that argon can be conveyed to this part of the heated material and so prevent contamination. This type of welding is eminently suitable for flat sheets and welds. For complicated components, however, it is difficult to make a jig with an argon backing at every weld point, and welding boxes are more generally used. Welding chambers are made in a variety of sizes to suit components, so that argon, which is an expensive gas, can be used in the most economical manner.

The boxes are of welded construction in mild steel plate with a window of Perspex or shatter-proof plate glass, through which the inside of the cabinet can be viewed by the operator. Manipulation of the welding torch and rods within the chamber is carried out by means of rubber gloves through a sealed opening at the front of the box. Means of exhausting the box by vacuum pump and charging it with argon after evacuation are provided. The best kind of vacuum pump for this work is the rotary oil immersion type. A high degree of vacuum can be obtained, and a single charge of argon after evacuation is satisfactory. The welds produced in these chambers are silvery in appearance and uncontaminated.

Titanium is a metal which is susceptible to work hardening and fatigue, and where a component has been subject to heavy forming, or welding where high residual thermal stresses may appear, it is subjected to a stress relief heating operation. This is carried out at between 450° and 500°C. in an electric muffle, for a period dependent upon the gauge of the metal involved.

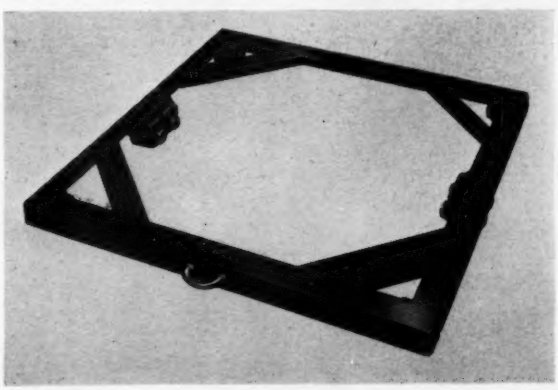
Pallet Handling

BOTH empty and loaded pallets up to 4,500 lb. capacity can be pulled or pushed in any direction on the low-loading framework of a bogie truck introduced by Powell and Company, Burry Port, Carms, South Wales. They can also be rotated through 360°, if required, for positioning. Empty pallets can be stacked on the bogie, then manhandled for storage into corners, lifts, etc., where a fork lift truck could not go, thus leaving more room for handling loaded pallets.

For short distances the bogie can also be used to move a loaded pallet by means of a tow-truck, when a fork lift truck is otherwise engaged or where space or headroom is too limited for the fork lift truck to manoeuvre. Towing lugs are provided.

All rollers are of wide tread, machined from the solid steel bar, and have alloy steel roller bearings. The main running rollers are in pairs and are mounted on a slightly lower plane than the corner rollers so that the bogie can pivot freely if required. The welded steel frame is carefully designed and suitably braced for maximum rigidity.

The standard bogie measures 40 in × 40 in.; models for other sized pallets can be designed.



The low loading bogie truck designed to facilitate pallet handling that has been introduced by Powell and Company

Foundry Briefs

Mottling in Anodized Gravity Die-Castings

Among the many difficulties arising from the anodizing of die-castings, the majority arise from efforts to achieve satisfactory finishes on alloys which are basically unsuitable by reason of their silicon content. Founding problems also cause a number of faults, and in the instance described here, both sources of trouble were suggested as being partly responsible.

By COUNSEL

ALTHOUGH current advances in anodizing techniques have minimized the many uncertainties which attended early processing of this type, it still remains necessary to ensure sound castings if a satisfactory finish is to be obtained. This investigation followed the occurrence of mottled surfaces on gravity die-cast covers in D.T.D.276A alloy. In the sample submitted for examination, the surface of the casting bore many bright areas which had not been anodized, giving the mottled effect which caused complaint (Fig. 1).

The surface of the casting was black, having been anodized and dyed. A large part of the original casting had been machined before anodizing and the incidence of mottling on this part was greater than on the "as cast" surface.

The bright un-anodized areas of the surface appeared, at low magnification, to be associated with minute defects, and removal of the dyed layer revealed many such discontinuities distributed evenly throughout the machined surfaces.

A section of the casting was polished and examined on the microscope, and a great number of cavities were found to be present, a typical example of one of these cavities being shown in Fig. 2.

The explanation of the mottled effect clearly lay in its association with these cavities since under each of the spots a defective area such as that shown in Fig. 2 was found. After the castings are cleaned, and prior to anodizing, there is the probability that cleaning fluid may be held in these imperfections in the casting surface, its presence preventing satisfactory anodizing.

The attention of the foundry concerned was drawn to the fact that it is accepted practice in many instances to add a certain amount of gas to gravity die-castings in order to prevent localized shrinkage porosity. Where gravity die-castings have to be machined and subsequently anodized, however, such a practice would not be accepted. The metal requires careful degassing before casting, and if shrinkage cavities result then die design and feeding arrangements would have to be modified to overcome them without recourse to "gassing" of the melt. A proprietary

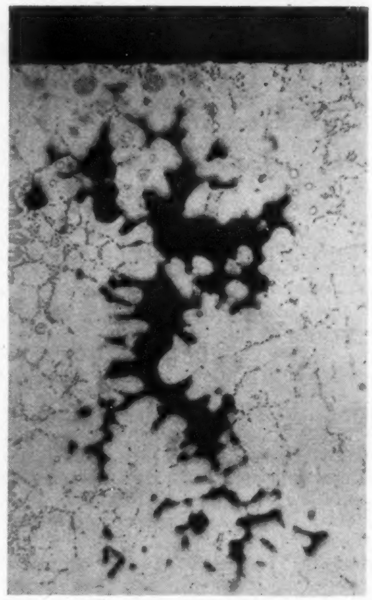


Fig. 2—Microsection showing gas cavities with which mottling was associated

degasser was already in use, but it was suggested that some tests be carried out using this material, which would provide experience for optimum results with the castings in question.

In view of the difficulties commonly associated with colour anodizing of silicon-bearing alloys, it was suggested that an alloy of a composition similar to LM.5 should be used unless there were very strong reasons opposing the adoption of a magnesium-bearing alloy.

[This note is based on an investigation carried out for one of their customers by Foundry Services Ltd.]

Fig. 1—Gravity die-casting showing incidence of mottling of anodized surface

Piston Repairs

SIGMA welding is being used in the United States to reclaim aluminium diesel locomotive pistons. By removing the old worn ring carrier and welding a new cast aluminium carrier in place, the piston is returned to service at a fraction of the new-part cost. Pistons can be rebuilt as many as five times, and reclamation has increased the life of some pistons by more than two million miles.

After the worn ring carrier is removed, the piston is degreased and machined. The new aluminium carrier is put in place and the assembly is mounted on a positioning fixture for welding.

Finishing Supplement

Service Blistering of Plated Zinc Alloy Die-Castings

By V. E. CARTER and J. EDWARDS, Ph.D.

(Communication from The British Non-Ferrous Metals Research Association)

This investigation into the service performance of plated zinc alloy die-castings was initiated by the British Non-Ferrous Metals Research Association and the work described has been made available to its members in Report No. RRA1171. Mr. Carter is a research assistant, and Dr. Edwards is head of the electrodeposition section at the Association.

SERVICE blistering of nickel + chromium plated die-castings is generally believed to arise from corrosion of the basis metal following penetration of the coating. It is, however, sometimes suggested that blisters may occur in service without penetration of the coating having taken place, a view which acquires plausibility from the observation that process blisters occasionally appear some time after processing. It seems unlikely, however, that blisters caused by trapped electrolyte could take more than a day or two to develop, and they would certainly be expected to be in evidence by the time a die-cast component is fitted to a motor car, for example. The possibility of inter-diffusion of the copper deposit and the zinc base contributing to delayed blistering is also small, at least for normal conditions of service.

To resolve any remaining doubt it was decided to examine carefully the first blisters appearing on a representative sample of plated die-castings exposed to a corrosive atmosphere. This examination showed that all the blisters occurred at the sites of perforations in the coating, indicating that the service performance of plated zinc alloy die-castings is determined primarily by the resistance to penetration of the coating.

If a conventional copper + nickel + chromium coating is used, resistance to penetration depends mainly on thickness, assuming the deposits to be of good quality and free from gross defects. Certain estimates have been made of the coating thickness necessary to ensure acceptable performance.[1,2,3,4] With the aim of adding to the available data, the opportunity was taken of continuing the exposure of the plated castings referred to above: the castings were inspected at intervals and thickness determinations were made on selected castings at the end of the tests in order to determine the relationships between durability and coating thickness.

Selection of Specimens

All the specimens tested were cast in Mazak 3 die-casting alloy by one company, about half of them being plated by the same company (Plater A) and the remainder by one of their customers (Plater B). Five or six plated castings, covering a variety of shapes and sizes, were taken at random each week from the normal production at each factory. In this way, 192 samples were collected in a period of approximately six months.

All the castings were plated with copper + nickel + chromium according to normal commercial practice, but Plater A employed dull nickel which was buffed before chromium plating, while Plater B employed bright nickel.

Exposure Conditions

After degreasing and a careful examination to ensure freedom from surface defects, the specimens were exposed to a fairly severe industrial atmosphere on the roof of the Association's laboratories at Euston. They were laid on horizontal teak runners raised 9 in. above the roof, which is itself some 40 ft. above street level. No specimen was cleaned until some blistering had taken place and the specimen had been removed for microscopic examination of the blisters. Following re-exposure of the specimens, they were cleaned before each inspection, at approximately monthly intervals, by rubbing with a paste of Vienna lime and water on a stockinette pad, and washing off with water.

The exposure tests were begun in August, 1956, and terminated in July, 1957; since each casting was removed from test for a period of three months for investigation of the initial stages of blistering, the total exposure period was eight months.

Assessment of Corrosion

As soon as it was observed that blistering had occurred on a plated casting it was removed for examination under a binocular microscope. All the blisters were examined for the presence of a perforation in the coating. In cases where it was not certain that corrosion of the basis metal could have occurred through a hole in the coating, the blisters were cut open to determine whether they were full of solid corrosion product.

After re-exposure, specimens were inspected at approximately monthly intervals (after cleaning) and given

TABLE I—SCALE OF RATINGS

Appearance	Rating
Complete freedom from blistering	5
Very few blisters	4
Moderate number of blisters	3
Considerable blistering with loss of decorative value	2
Severe blistering	1
Complete failure	0

Fig. 1—Resistance to blistering in severe industrial atmosphere of plated zinc alloy die-castings as a function of nickel thickness : left, 8 months' exposure ; right, 12 months' exposure (estimated)

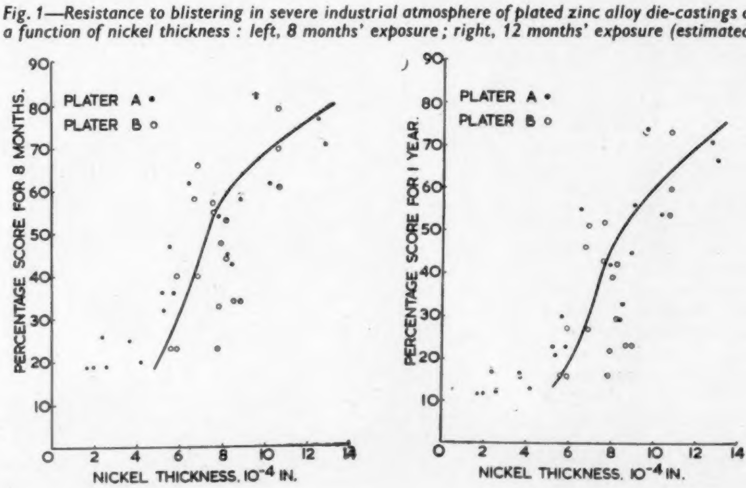


TABLE II—COPPER AND NICKEL DEPOSITS AND "PERCENTAGE SCORES"

PLATER A				PLATER B			
Thickness 10^{-4} in.		Percentage Score		Thickness 10^{-4} in.		Percentage Score	
Cu	Ni	8 months	1 year	Cu	Ni	8 months	1 year
1·7	1·7	19	12	2·1	4·2	20	13
2·5	2·0	19	12	2·5	5·6	23	16
1·3	2·6	19	12	2·5	5·9	23	16
1·7	3·7	25	17	2·5	7·8	23	16
0·4	2·4	26	17	3·4	7·9	33	22
0·8	5·3	32	21	4·2	8·6	34	23
0·8	5·2	36	23	3·4	8·9	34	23
0·8	5·8	36	23	2·5	5·9	40	27
0·8	8·5	43	33	3·4	6·9	40	27
0·5	8·3	45	29	3·4	8·2	44	29
1·7	5·6	47	30	3·4	8·0	48	39
0·8	7·9	54	42	2·9	8·2	53	42
0·4	8·9	58	45	2·8	7·6	55	43
0·4	6·5	62	55	3·4	7·6	57	52
0·4	10·3	62	54	3·4	6·7	58	46
0·8	9·0	64	56	4·2	10·7	61	54
1·7	12·9	71	67	3·4	6·9	66	51
0·8	12·6	77	71	3·4	10·7	70	60
1·7	9·6	82	74	4·2	10·7	79	73

ratings according to the scale shown in Table I.

Assessment according to Table I is largely qualitative, as may be seen; while it would be possible to express each rating in terms of the number of blisters per unit area for flat specimens, it was not felt to be practicable for specimens of widely varied shape and size.

Each specimen was assigned a score for the period between successive inspections by multiplying the average rating for the period by the number of weeks. Adding these scores gave a total score for the whole period of testing, which was compared with the maximum possible score (five times the number of weeks) to give the "percentage score"; this was used as the basis of comparison between different specimens.

Coating Thickness

At the conclusion of the tests, the specimens were grouped according to their resistance to blistering, the groups covering the following ranges of "percentage score": (a) less than 25 per cent, (b) 25-35 per cent, (c) 35-45 per cent, (d) 45-55 per cent, (e) 55-65 per cent, (f) greater than 65 per cent. Six or seven specimens were chosen from each group for determination of thickness, approximately equal numbers being taken of castings plated by Platers A and B.

Many of the specimens used in this investigation were unsuitable for an examination of the relationship between durability and coating thickness. On castings which were highly complex in shape, or had a mainly patterned surface, it would have been practically impossible to determine any thickness which could be said to be representative of the entire surface. The castings selected were, therefore, those of which a fair proportion of the surface was smooth and approached a simple geometrical form (flat or cylindrical, for example). Microsections were taken through the centre of such areas, mounting the specimens in a cold-setting resin and polishing with various grades of emery, and, finally, diamond. The thicknesses of the copper and nickel deposits were measured on a projection microscope at a magnification of 1,000. For practical purposes the thicknesses measured can be taken as being near the minima for each casting.

Blister Formation

The first blisters to appear on every plated casting exposed in the tests were carefully examined under the microscope. A small hole in the coating was visible at the top of every blister. In some cases the initial pit had been enlarged by cracking of the coating caused by the eruption of the blister, and white corrosion product could be seen in the hole. Surface examination of some small blisters failed to show conclusively that the pit penetrated the coating, but cutting open such blisters revealed that they were full of corrosion product, indicating that there must have been a perforation in the coating, permitting the escape of gaseous products of corrosion (hydrogen) and probably providing the means of entry for corrosive agents.

Process blisters, occurring during or shortly after plating, usually contain very little solid corrosion product, and since they are formed in most cases by the pressure of gas generated (or expanded, at least) beneath the coating, the coating must not be perforated. The fact that the blisters examined in the present work were perforated and were full of solid corrosion product, demonstrated conclusively that they were formed by corrosion of the basis metal following penetration of the coating. Since not one blister was found without these characteristics, it seems most unlikely that blisters of any other kind (such as delayed process blisters) contribute appreciably to the deterioration of plated zinc alloy die-castings in service.

Influence of Thickness

The thicknesses of the copper and nickel deposits on the castings examined, and the percentage scores for the eight-month exposure period, are shown in Table II. Estimated percentage scores for one year's exposure are also listed; these were calculated on the assumption that no further deterioration in surface appearance would occur in a further four months' exposure.

The Table shows that the thickness of the copper varied widely between 0·00004 in. and 0·00042 in. In general, the copper deposits applied by Plater A were much thinner than those applied by Plater B. When percentage scores were plotted against the total coating thickness, there was a wide scatter of results, and the points for Platers A and B formed two virtually separate groups. Plots of percentage score against nickel thickness plus a half, and then a quarter, of the copper thickness showed progressively reduced scatter, and the best result was finally achieved by neglecting the copper and plotting percentage score against nickel thickness alone, as in Fig. 1. Complete overlapping of the two sets of results (for Platers A and B) is apparent in the two graphs shown, except at the lower end of the curves. The superiority of the castings plated by Plater A in this region might be thought to indicate that increasing the thickness of copper actually has a harmful effect when the nickel deposit is thin, but reference to Table II shows that the particular castings concerned did not, in fact, have greatly different thicknesses of copper. It is possible that the difference is due to the difference in the nickel deposits; buffed dull nickel (as used by Plater A) may be more protective than bright nickel (as used by Plater B) in this range of thickness. Nevertheless, in view of the few data and the many uncontrolled variables this conclusion cannot be drawn with any confidence.

It is shown fairly conclusively in Fig. 1, however, that resistance to blistering is strongly dependent on the thickness of the nickel deposit, and is probably little affected by variations in the copper thickness. The curves indicate that durability increases rapidly as the nickel thickness is increased, especially up to about 0·0009 in. To some extent, however, the actual shape of the curves must depend on the scale of ratings used and the period of exposure, and it is difficult on the basis of these data to make a case for any particular thickness of nickel to be applied to castings

(*Continued on page* 194)

TURRET PRESS FACILITATES RAPID PUNCHING OF VARYING SIZE HOLES

Short Run Presswork

ELIMINATING the costly and somewhat laborious method of marking out, drilling and opening up the apertures in short- and medium-run sheet and plate piercing, and replacing these old-fashioned methods with an up-to-date system of quickly and accurately locating the hole centres, and piercing the complete panel without removing it from the press, the British Wiedemann Turret Punch Press R.44 is being marketed in this country by Dowding and Doll Ltd., 346 Kensington High Street, London, W.14.

All classes of work from miniature laminated plastic wiring boards to large metal plates can be handled, and modifications in size, position, or shape of any of the openings can be readily made. All the punches and dies necessary for piercing the complete blank are carried in rotating turrets, and any tool set can be rapidly indexed to the working position. Only one pair of tools of each particular size or shape is needed, and the same set of tools can be used on any layout.

Any of three different methods can be used for quickly and accurately locating the positions of the openings. This means, of course, that the best method can be selected for the particular job on hand.

On medium-length runs, or when the layout is complicated, piercing through a template will generally prove to be the most economical method. Coloured "routes" painted on the template ensure that all openings of the same size are pierced consecutively, a similarly-coloured tab on the turret identifying the appropriate punch. By following these "routes" the operator both minimizes the number of turret movements and reduces handling.

The template is located under the punch, which is lowered into the appropriate opening by means of a small lever conveniently placed to the right of the turret. When the punch has entered to a depth that can be pre-set, the press trips. It is impossible to trip the press until the punch has actually entered the opening in the template. This safety device is controlled by a micro-switch with a screw adjustment, enabling blanks up to $\frac{1}{4}$ in. thick and templates from $\frac{3}{32}$ in. to $\frac{1}{8}$ in. thick to be accommodated.

With accurate templates, dimensional accuracy of the work can be readily achieved. The operating method is then as follows:—

With the punch floating just above the template, the aperture can be quickly and easily located. The punch is lowered into the template and as the tripping point is reached, the micro-switch operates and the press trips. The blank is then pierced and stripped from the punch, which once more floats above the template.

Three fixed stops, or buttons, fitted to the template, locate the blank on two sides. Cams on the remaining sides clamp the blank to the template.

For short runs it is often more economical, and for bulky jobs more convenient, to use the rack gauge table. The standard rack gauge table permits work up to 72 in. long to be handled, but longer tables can be supplied if required. No template is needed, "In-Out" dimensions being set to a gauge bar operated by leadscrews coupled to a graduated collar. Crosswise dimensions are obtained by means of rack stops with teeth cut on their end faces to engage with two

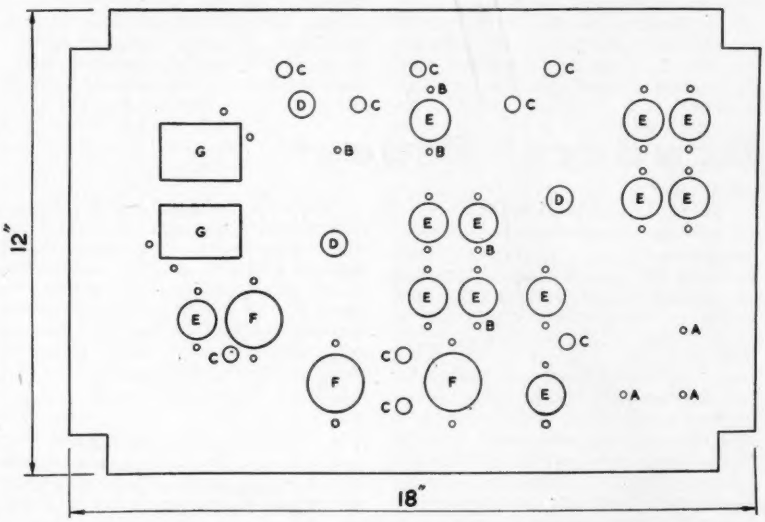
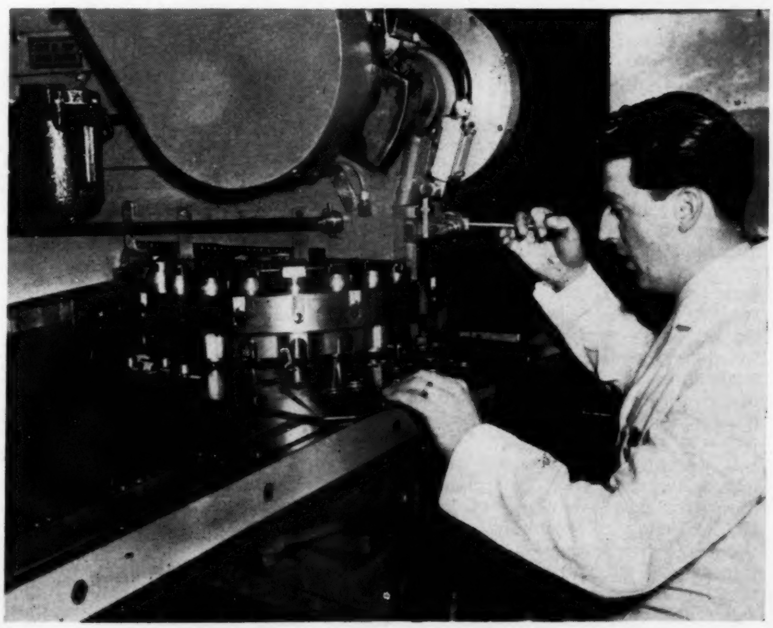


Fig. 1—Layout of sample plate, with 67 apertures of varying size and shape

Fig. 2—The turret head of the British Wiedemann turret punch press



long racks extending along the length of the table. A large number of stops can be positioned at one setting. The stops are fitted with spring-loaded pins, which can be depressed and locked when the stop is not in use.

A standard gauge attachment provides a simple means of locating the position of apertures on a wide range of work in small or medium batches. "In-Out" dimensions are set to a back gauge bar, which is positioned by lead-screws coupled to a graduated collar. Crosswise dimensions are quickly set by moving end stops along a fixed scale which indicates the distance to the left or to the right of the punch centre-line.

In the Wiedemann method of piercing, a threefold saving in production time is achieved. First, handling time is reduced, since most apertures can be pierced in one operation without removing the blank from the press. Second, the actual piercing time is reduced, since all the necessary punches and dies are carried in the rotating turrets and the next set is always ready for instant use. Third, since all apertures are pierced cleanly and accurately to size and shape, the work of opening up and finishing to size is entirely eliminated.

In the example shown in Fig. 1, all 67 apertures, varying in size from ⅛ in. to 1½ in. diameter, including the 2 in × 1⅝ in. rectangles and corner notches, were pierced complete in a floor-to-floor time of only 5 min. 17 sec. These are typical of the times being regularly recorded on the Wiedemann R.44.

One tool set of each size only is necessary, the same set being used for all similar openings, irrespective of the layout. Furthermore, unlimited modifications in design can be made in a matter of minutes, and no heavy expenditure in alterations to tooling is involved.

Turrets can be supplied with 16, 18, or 20 stations, and turret movement is synchronized to ensure that the punches and dies are always in perfect alignment.

The R.44 will take any size of punch from 3⅛ in. diameter down to the smallest sizes. Punches are made in five diameter ranges: up to 1 in., 1 in. to 1½ in.; 1½ in. to 2 in.; 2 in. to 2½ in.; 2½ in. to 3⅛ in. Their accuracy makes all punches within each of these ranges interchangeable, and there is no need to re-align the holders.

For stations up to 1½ in. diameter, dog type die holders are used, and for stations with punches exceeding 1½ in. diameter self-aligning die holders are used.

Readers' Digest

HOT DIP GALVANIZING

"Hot Dip Galvanizing 1956." *Published by Zinc Development Association, 34 Berkeley Square, London W.1. Pp. ix + 232. Price 45s. 0d.*

AMONG the many methods of rust prevention for steel, particularly in outdoor applications, one of the oldest, and still the most efficient is hot dip galvanizing. Because the process has been operated for a long time there has been, until recent years, a tendency for little new development to take place, and it was not until the Hot Dip Galvanizers' Association was formed that much attention was focused on improving the methods used throughout the industry. This book puts on permanent record the proceedings of the 4th International Galvanizing Conference held in Milan in 1956, and therefore records much of the progress made up to that time.

Eleven Papers and the relevant discussion together with the report of an informal discussion are collected into ten chapters. Covering a wide range of topics the Papers include :—a survey of galvanizing practice in 1955, the influence of impurities in iron on attack by molten zinc, galvanizing pot construction, heating and performance of galvanizing baths, electrical resistance heating for baths, gas immersion heaters, work study applied to galvanizing, galvanizing angle sections, galvanizing of cast iron, galvanizing wire netting, painting of hot dip galvanized steel, and new markets for galvanizing.

With the present trend towards increasing efficiency, more pronounced than ever now that signs of keener competition are becoming apparent, the detailed investigation carried out into general galvanizing by a team of work study specialists will be of especial interest.

The work described in these Papers covers galvanizing practice in several different countries, and some of the methods adopted provide interesting comparisons with those in use in this country, and for that reason alone the book should be of interest to all galvanizers. For users of steel, especially structural work, there is also much that will be of interest.

A.S.T.M. STANDARDS

"1957 Supplements to Book of A.S.T.M. Standards." *(Part 2—Non-Ferrous Metals; Part 6—Rubber, Plastics, Electrical Insulation.) Published by American Society for Testing Materials, 1916, Race St. Philadelphia Pa. U.S.A. Part 2. Pp. xi+380. Part 6. xi+424. Price $4.00 each.*

THESE two issues of parts of the 1957 Supplement to the 1955 edition of A.S.T.M. Standards, bring up to date the changes in the withdrawal and issue of standards and tentatives in their respective fields. The book dealing with non-ferrous metals includes standards covering copper and copper-base alloys; aluminium and aluminium-base alloys; magnesium and magnesium-base alloys; electrical heating; resistance and related alloys for radio tubes; electrodeposited metallic coatings; die-cast metals; corrosion tests and general methods of testing. Sixteen of the seventeen standards are replacements of existing ones, another is a revision of a tentative adopted in 1957. Of 41 tentatives, 33 are replacements of existing tentatives, 8 being published for the first time.

Part 6 deals with rubber products (chemical, physical, ageing, and low temperature tests); automotive and aeronautical rubber; packing and gasket materials; hose; insulated wire and cable; carbon black; electronics materials; plastics (specifications; strength; hardness, thermal, optical, and permanence properties; analytical methods, moulds and moulding processes, definitions and nomenclature.

Service Blistering of Plated Zinc Alloy Die-Castings

—continued from page 192

intended for outdoor use. It was to assist in this, however, that the curve was drawn showing estimated percentage scores for one year's exposure. Plated steel specimens assessed in a similar way to the plated die-castings have normally been expected to attain scores of at least 50 per cent for one year's exposure in the Euston atmosphere. If this criterion is adopted, it is clear that 0·0009 in. nickel at least is required on zinc alloy die-castings. The estimated percentage scores for one year assume no deterioration in the last four months of exposure, and since this is particularly likely to prove false for articles retaining a relatively high rating up to eight months, it may well be that a rather greater thickness of nickel (0·001 in., perhaps) should be specified.

The authors are grateful to the Director and Council of The British Non-Ferrous Metals Research Association for permission to publish this Paper.

References

1. E. A. Anderson and C. E. Reinhard; *Plating*, 1948, **35** (2), 145.
2. C. F. Nixon; *Monthly Rev. Am. Electroplaters' Soc.*, 1945, **32** (11), 1104.
3. M. R. Caldwell, L. B. Sperry, L. M. Norse and H. K. Delong; *Plating*, 1952, **39** (2), 142.
4. American Society for Metals, *Met. Progress*, 1955, Aug. 15, **68** (2A), 97 (Supplement to *Metals Handbook*, 1948).

Design of Die-Castings

VI—Some Structural Features of Die-cast Parts

By H. K. BARTON

(Concluded from METAL INDUSTRY, *28 February* 1958)

BOX-LIKE components without internal partitions seldom call for special provision so long as the core surfaces are free from drags and adquate draft is allowed. Such parts can be ejected by means of ejectors, placed as in Fig. 14, unless the walls are of exceptionally thin section. Whatever the wall thickness, the ejectors are made at least ¼ in. diameter in order both to minimize the bearing area and avoid the possibility of the pins deflecting under load. This is the more likely when the wall is very thin.

It is good practice to stiffen up such sections by adding tapering buttresses, running out to nothing part way up the walls, as in Fig. 15, or joining up with internal ribs. It is, of course, common practice to provide the former sort for attachment purposes, the buttress being drilled and tapped, or cast with an integral rivet. Where this is so, there can seldom be any objection to increasing the number of buttresses so that some of them—particularly near the corners of the component—are available as ejector locations. If the buttress is cut in the core to a depth a little short of the base of the casting wall, as at *a* in Fig. 16, there is no need for a separate operation, after trimming, to remove traces of the ejector locations. It is, in fact, advantageous to adopt this practice even when the buttress does not provide an ejector location, since any burr formed when the hole is tapped is then so placed as not to affect assembly.

The location of cored holes in internal projections, like that at *a* of Fig. 16, rather than in external bosses, as at *b*, is generally to be preferred on grounds of styling and for ease of production. Since it is normally the exterior of castings that require polishing and plating, or spraying, the fewer projections and recesses there are on the outside surface, the better. Moreover, a smooth and regular perimeter simplifies flash removal. As many structural features as possible—ribs, bosses, buttresses and the like—should be located inside the component. Functionally, this is often a matter of indifference; what is required is a set of bearing surfaces disposed in a precise spatial relation, as indicated schematically at *a* in Fig. 17. Whether the web uniting these functioning elements is external to them, as at *b*, or leaves them projecting, as in *c*, at the bottom, can normally be decided on grounds of convenience and appearance.

Ribs as separate features can sometimes be eliminated by changing the external conformation of the component; thus, the projecting channel section of *b*, Fig. 17, provides approximately equal rigidity to the conventional internally-ribbed construction at *c*, with a small saving in weight. Properly handled, firm and unhesitating changes of contour such as this can add much to the appearance of the product, and do more to create an impression of strength than can an array of external bosses and ribs. In fact, visible stiffening ribs tend to create an adverse impression, the prospective buyer of the product feeling obscurely that they are there to counteract inherent structural weakness.

This is not to say that ribs themselves cannot be used as formal elements in styling a product; it has often been demonstrated that they can. Even so, the most satisfactory effects have resulted from the adoption of much more massive ribs than are structurally necessary, so that they have had to be cored out from the rear. The transition from structural to "styled" ribbing is seen in Fig. 18. The essential difference between *a* and *b* is that in the latter the web between each pair of ribs has been moved from

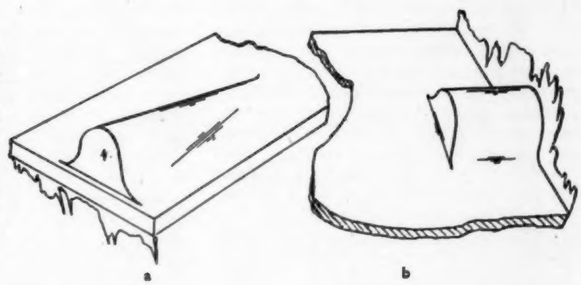
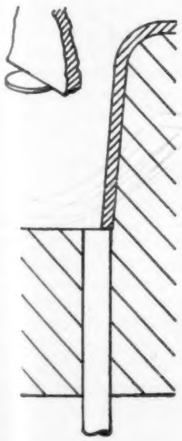


Fig. 16—Internal buttresses that are to be drilled and tapped for assembly are often best set slightly back from the edge of the casting (left). Such features allow of easier trimming than the equivalent outside lug shown on the right

Below left: Fig. 14—Large ejectors can be used to eject thin-walled castings in the manner shown, but if the ejectors are forced back by metal pressure, projecting ears or "buttons" (inset) may be formed

Below right:—Fig. 15—Internal buttresses both stiffen thin-walled castings and, as here, provide effective bearing areas for ejectors



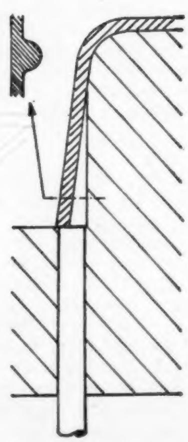


*Fig. 17—The structural and functional features of sketch **a** can be connected by a thin web in a variety of ways of which two are indicated at **b** and **c***

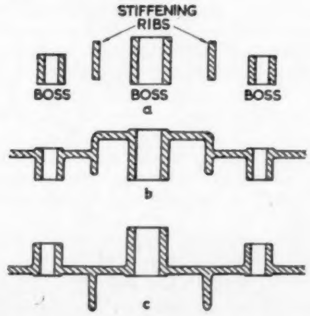
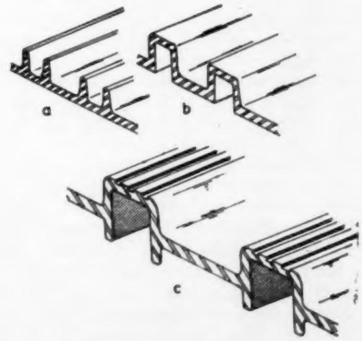


Fig. 18—Properly proportioned, ribs can constitute dominant elements in the styling of a die-cast component



the root to the tip, giving two rugged-looking ribs instead of four slender ones. So far as rigidity and strength are concerned, *a* and *b* differ little from *c*. Here, the actual height of each stiffening element is unaltered, but the position of the web is raised so as to give a shallower external projection. In practice, of course, these variant forms need not necessarily be dissociated; an external feature may vary from section *b* to *c*, and thence be faired into the general contours of the component with the ribs wholly internal.

Apart from a few highly-specialized applications, among which coffin furniture and juke-box trim are noteworthy, die-castings are to-day mercifully free from the wilder sorts of surface diversification — the debased floral and foliage motifs and the even more debased geometric "futuristic" patterns—that afflicted so many of them a few years ago. The present trend, and a highly commendable one, is to eschew solely decorative features applied for their own sake, and instead to integrate structural features into a "styled" unity of design that relies for its effect upon economy of line.

This trend accords well with the operational requirements of the die-casting process, for it is easier to obtain strength and a superfine "hardware" finish in smoothly-contoured castings of thin and even section than in components with abrupt changes of plane, suddenly varying wall thicknesses and surfaces covered with decorative elements in high and irregular relief. Yet even to-day one is likely to encounter with some frequency projected designs for die-castings in which there is only a superficial conformity with contemporary styling; a general "streamlining" of external form is achieved, but without relation to the structural requirements of the component. As a result, one finds sudden changes in wall thickness and local concentrations of mass that are not only operationally undesirable, but functionally so, since they detract from the strength and solidity of the product. Good styling grows out of functional necessities: whereas at one time domestic appliances—to take only one field of application—were commonly designed with a smooth carapace concealing a separate mechanical skeleton, the advance of die-casting and other "precision casting" processes has now made it possible to combine both functions in single units. But to take fullest advantage of the opportunities this offers, the designer must think at one and the same time in terms of product function and product appearance, so that structure and styling grow together under his hand. If a product is to measure up to present-day design standards, "styling" is no longer something to be added after the really important features of an article have been decided upon. In no field is this concept of the unity of product design more important than in die-casting, for while no process is more responsive to good design, it is equally true that the adaptability of die-casting, by reducing the penalties of bad design, has in the past lent itself to many poorly-conceived products.

Molybdenum-Base Alloys

SUPERIOR hot breakdown fabrication characteristics of the sintered product constitute the major difference between the best molybdenum-base alloys prepared by powder-metallurgy as compared with arc-casting methods. The underlying reason for this difference appears to lie in the finer initial grain size of the as-sintered powder-metallurgy alloy, and the fact that the impurities are distributed over a much larger grain-boundary area, thus making their presence innocuous. The room- and elevated temperature strengths of the best molybdenum-base alloys prepared by powder-metallurgy methods are equivalent to those of the best arc-cast alloys. However, because of higher oxygen contents usually found in powder-metallurgy-produced materials, the ductility of thin weldments is inferior to that of arc-cast alloys. These are some of the results of a long-term investigation carried out at Battelle Institute.

Initially, powder-metallurgy alloys made with conventional alloying additions were studied. The most effective alloying addition was silicon. Significant improvements in strength at room and elevated temperatures could be achieved with silicon alloy contents of the order of 0·1-0·2 per cent. Chromium also was found to be a good conventional alloying addition. One to two per cent may be added. These amounts improve room- and elevated - temperature strength and increase the recrystallization temperature range. Cobalt was found to have a high strengthening effect, but lowered the recrystallization range. The addition of tungsten resulted in alloys with excellent mechanical properties and improved recrystallization characteristics, however, tungsten had the lowest specific strengthening effect of any alloying addition and was not advantageous from a strength-weight point of view.

A new type of alloying addition to molybdenum was discovered in this research in which the addition of stable oxides produce dispersion hardening. The most suitable oxides were those which were available in the finest particle size, had high hardness, high stability, and high modulus of elasticity. The oxides of zirconium and titanium were most effective, with chromium oxide good, but somewhat less effective. The oxide dispersion alloys of molybdenum with 0·1-1 per cent ZrO_2 or TiO_2 were found to have 100 hr. rupture strength at 1,800°F., or three to four times that of unalloyed molybdenum.

The optimum alloys produced by arc-casting methods were those containing titanium or zirconium, the same elements which were found to be most effective when added as oxide dispersions to powder - metallurgy molybdenum alloys. It was concluded that the mechanism for improvement in elevated-temperature strength was similar in both cases, part of the metallic alloy addition in the arc-melted alloys being oxidized during melting to produce fine dispersions of oxide.

The economic differences between arc-cast and powder-metallurgy molybdenum products are important. Thus, if advantage is taken of furnace sintering procedures, there will be almost no scrap generated in the primary breakdown operation of powder-metallurgy alloys. In the case of arc-cast alloys, on the other hand, the end losses in extrusion are inevitably high. However, if true hot-working procedures make a direct hot breakdown operation feasible for arc-cast alloys, the economic advantage disappears.

Obituary

Mr. H. T. Eatwell

WE regret to record the death of Mr. Henry Thomas Eatwell, A.M.I.E.E., managing director and joint deputy chairman of G. A. Harvey and Co. (London) Ltd. Mr. Eatwell joined the company in 1929 as a sales engineer in their heavy construction department, subsequently becoming its manager. Later, he became personal assistant to the senior director and works manager, and he was appointed a director in 1937, becoming managing director in 1947; in addition, he held the post of deputy chairman from 1952.

He was a vice-president and member of the executive committee of the Engineering and Allied Employers' London and District Association; a member of the board of management of the Royal Metal Trades Pension and Benevolent Society; a member of the council of the Zinc Development Association; a former chairman of the Hot-Dip Galvanizers' Association; and a member of various committees of the Galvanized Tank Manufacturers', and other Associations.

Industrial News *Home and Overseas*

Scrap Metal Merchants

As a result of the scrutiny of the nomination forms sent in by members of the **National Association of Non-Ferrous Scrap Metal Merchants** for the purpose of electing a new Council of the association, it is now reported by the secretary that as the total number of nominees received was 17, it will not be necessary for a postal vote to be taken as the rules provide that the Council shall consist of 17 members.

The names of the members of the new Council, therefore, are declared to be as follows:—D. J. Austin (E. Austin and Sons (London) Ltd.), R. O. Barnett (Arthur E. Milner (Metals) Ltd.), P. A. Benson (F. W. Harris (Birmingham) Ltd.), V. Brenner (Deutsch and Brenner Ltd.), C. H. Chick (H. B. Barnard and Sons Ltd.), M. C. Elton (Elton, Levy and Co. Ltd.), M. A. Engers (M. C. Engers Ltd.), G. B. Garnham (J. B. Garnham and Sons Ltd.), C. R. Hague (C. R. Hague and Co. Ltd.), P. O. Jones (Brookside Metal Co. Ltd.), M. N. Joseph (H. Barnett Ltd.), L. Lazarus (Leopold Lazarus Ltd.), J. K. Lion (Philipp and Lion), S. W. Platt (Platt Metals Ltd.), A. G. Robinson (C. A. Robinson and Co. (Greenwich) Ltd.), H. G. Shields (E. Chalmers and Co. Ltd.), and Mr. T. R. White (James Mahoney and Co. Ltd.).

In view of the fact that the hon. treasurer is an *ex officio* member of the Council, it is not necessary for Mr. A. C. W. Wood to resign from that office.

Contract for British Oxygen

The use of argon to provide an inert atmosphere plays an essential part in the United Kingdom Atomic Energy Authority's project at Dounreay. The gas employed for this purpose must reach exceptional standards of purity, since even the smallest contamination by air will render it useless.

In order to avoid unnecessary waste of this valuable gas, the Authority has awarded a contract to **British Oxygen Engineering Ltd.** for the installation of a special plant which will remove all traces of air from the gas and return it to its original state of high purity. Basically, the process is one of injection of hydrogen into the impure gas to act as a reducing agent by removing oxygen in the form of water, and of subsequent low temperature distillation for nitrogen removal.

Refrigeration for the process is provided by the use of liquid oxygen, and the contract awarded to British Oxygen includes the provision of two small liquid oxygen plants and a liquid oxygen storage vessel.

Aluminium in Greece

An expert of the U.S. concern, Kaiser Engineers, has been visiting Greece for consultations with the authorities on the question of building an aluminium electrolysis plant in the Parnassus area, near extensive bauxite deposits. It is understood that Kaiser has already tested samples of Greek bauxite, and also brown coal and brown coal briquettes from the Ptolemais area.

Dust Collection

A major improvement in the field of dust collection is the new Mikro-Pulsaire Collector, an American machine which is now manufactured under licence in this country and marketed by **Pulverizing Machinery Limited.** It is said that the main advantage of this collector is the complete absence of internal moving parts. It uses a method of continuous air filtering of powder and dusts which dispenses with the need for mechanical systems of filter cleaning.

The principle is ingenious and has all the advantages of simplicity. The dust-carrying air passes into cylindrical filter elements, composed of woollen and synthetic felts, 4 ft. or 6 ft. long, leaving the dust to fall from their external surfaces to be collected at the bottom of the pressure cabinet.

The problem of clearing the thick layers of dust from the filter cloths covering the cylinders has been solved by providing periodical high-pressure air currents in the reverse direction to the filter flow—from inside the cylinders. Above the opening in the head of each cylinder is a nozzle connected to a compressed air supply of 60 lb/in^2 through a solenoid control valve. An electrical timer opens each valve in sequence for whatever period and frequency is desired. The contoured design of the cylinder openings brings about venturi action and induces a secondary flow of sufficient volume and pressure to clear the filter cloths against the filter flow pressure. The dust adhering to the outside of the filters is literally blown away before it is thick enough to impede the rate of collection.

Selling Agents

It has been announced by **Twiflex Couplings Ltd.,** a subsidiary of Sheepbridge Engineering Ltd., that Caselco Ltd., of 46 Park Square, Leeds, have been appointed sole selling agents for the county of Yorkshire. In future they will handle the complete range of Twiflex products, including automatic clutch couplings and flexible couplings capable of transmitting up to several thousand horse-power. Overrun couplings, hold-back brakes and other products will also be available.

Change of Address

It is announced by **Powder Metallurgy Ltd.** that their headquarters are now situate at P.O. Box 500, Berk House, Portman Square, London, W.1, with the telephone number of Hunter 6688. This address, it should be noted, is also that of the Berk group of companies.

Building Materials

In association with the Birmingham and Five Counties Architectural Association, the **Building Centre** is holding an exhibition of samples of some "Recent New Building Materials" in the Engineering Centre, Stephenson Place, Birmingham, from Tuesday, March 25, to Saturday, March 29, daily from 9 a.m. to 5 p.m.

The exhibition will be opened by Mr. Harmar Nicholls, J.P., M.P., Parliamentary Secretary to the Ministry of Works. This will be an exhibition of samples and no manufacturers' representatives will be present, but members of the Building Centre technical staff will be present to answer enquiries and distribute literature. It is hoped to be able to exhibit about forty or fifty new products that have come on to the market in recent months.

British Foundrymen

An interesting lecture will be given on Wednesday next, March 12, to the members of the Southampton section of the **Institute of British Foundrymen** at the Technical College, St. Mary's Street, Southampton, at 7.30 p.m. The lecturer will be Mr. A. L. Parrott (Morris, Singer Company Ltd.) and his subject will be "Fifty Years of Art Founding."

On Friday next, March 14, members of the Beds. and Herts. section of the Institute will visit the works of Foundry Equipment Ltd., of Leighton Buzzard, where demonstrations of machines, technical films and the like will be given.

New Wire Rope

Introduction of a new type of wire rope sleeve has just been announced by **British Ropes Ltd.** This new rope, known as the "Superloop," is said to be a really safe mechanical splice with new type slimmer, tapered sleeve and a true centre pull. This device embodies a steel sleeve closed over the tails of a Flemish eye splice, and it is stated to be eminently suitable for Blue Strand preformed wire rope. The present range covers rope diameters from $\frac{5}{16}$ in. to $1\frac{1}{2}$ in.

The tapered tail of the sleeve and its small dimensions enables this new device to be employed in very many applications. The "Superloop" is concentric with the rope because of the Flemish eye, which is incorporated. This method of forming a loop develops a strength well in excess of the safe working load even before the sleeve is fitted. A specially-developed fitting, known as a Superloop Stirrup, is available to protect the bearing of the eye from wear. A new brochure, giving full details of this device, is available to industry on application to the company.

Canadian Metals for India

Canada has offered to supply ten million dollars' worth of non-ferrous metals to India under the Colombo Plan, the Indian Minister for Industry, Mr. Manubhai Shah, told Parliament last week. Replying to questions, the Minister said agreement had been reached with the Canadian Government for financing imports of aluminium, copper and nickel from this aid. Indian consumers, he said, would order these items from agents of Canadian manufacturers in India and the Government would then approach the Canadian Government for an allocation of funds to cover such orders.

News from Birmingham

A good level of employment continues in the Midland metal-consuming industries, although most manufacturers admit that new business is more difficult to obtain. Despite restrictions on the entry of British goods in some overseas markets, export orders represent quite a fair proportion of the contracts now in course of execution. Manufacturers of heavy electrical equipment are particularly fortunate in having on hand important contracts for power stations to be built in this country and elsewhere,

and they are also providing much of the electrical equipment for British Railways in their conversion schemes from steam to electricity. In the motor trade, the outlook continues favourable.

Iron foundries working for the motor trade are busy and there are good orders for heavy castings for the engineering industries. But there is no improvement in the market for builders' ironfoundry and brassfoundry. The steel sheet mills are well employed. Structural engineers have contracts which will keep them busy for some months, but the outlook is uncertain because of restrictions on capital expenditure. Imports of steel are gradually diminishing, due to the easier supply position at British steel works. Pressure for heavy steel plates continues.

Spring Meeting

Details of the Spring Meeting of **The Institute of Metals** have now been issued and are obtainable from the headquarters of the Institute at 17 Belgrave Square, London, S.W.1. The venue for the scientific and technical sessions is the Church House, Great Smith Street, London, S.W.1, and meetings will be held from Monday, April 28, to May 2.

This year is the **Golden Jubilee** of the Institute, and the "Golden Jubilee" Lecture will be given by Professor R. S. Hutton, M.A., D.Sc., at 8.15 p.m. on Monday, April 28, at the Royal Institution, Albemarle Street, S.W.1. The May Lecture will be given at 3 p.m. on April 29 by Professor A. G. Quarrell, D.Sc., Ph.D., A.R.C.S., D.I.C., who will take as his subject "Fifty Years of Metallurgical Science."

The Golden Jubilee Banquet will be held in the evening of May 1 at Grosvenor House, Park Lane, W.1, when the principal guest will be the Rt. Hon. The Lord Hailsham, P.C., Q.C., Lord President of the Council, who will propose the toast of the Institute of Metals and the Non-Ferrous Metals Industries. In addition to the technical sessions and other lectures, a series of all-day visits have been arranged, and also other visits for lady guests to the meeting.

It should be noted that the scientific and technical sessions and lectures will be open to non-members as well as to members of the Institute, and tickets of admission will not be required. Attendance at the social functions and visits, however, will be restricted to members of the Institute and their personal guests and official delegates to the meeting.

Visitor to Roto-Finish

Export manager of Schering's Electroplating Division, Mr. Skrodzki recently visited **Roto-Finish Ltd.**, the sole licensees in this country of the Schering range of bright nickel and bright silver plating processes. The purpose of his visit was to advise and consult with Roto-Finish on the possibility of extending the range of Schering's plating processes which are currently available in England. Mr. Skrodzki also toured factories in the Midlands and Sheffield areas, where he was able to advise customers on the range of his company's products.

Metal Finishing

Advance notice is given of the next luncheon meeting of the Birmingham area section of **The Metal Finishing Association.** This event will be held on Tuesday, March 25 next, at the Farcroft Hotel, Handsworth, at 12.30 p.m. and will be the final meeting of the session. The guest speaker on this occasion will be Mr. J. H. Barwell, J.P., a past-president of the Birmingham Rotary Club, and the subject of his address will be "The Rotary Movement."

Automatic Polishing Machines

We understand from **Electro-Chemical Engineering Co. Ltd.** that they have been appointed exclusive sales representatives in Great Britain for all products of ACME Manufacturing Company of Detroit. This latter company has recently started to manufacture automatic and semi-automatic polishing machines in a new factory at Neu-Isenburg, near Frankfurt-am-Main, built with the object of supplying their equipment to the European and non-dollar markets.

As representatives for these machines, the Electro-Chemical Engineering Co. are in a position to import the machines and carry out installations. Stocks of essential spares will be held in this country.

Electronic Digital Computers

In view of the established usage of electronic computers to scientific computation, and their potentialities to accountancy and other commercial procedures, the **Birmingham College of Technology** is organizing a series of one-day conferences on electronic digital computers and their industrial applications.

The first of this series, with special reference to Ferranti computers, will be held at the College at Gosta Green, Birmingham, on Wednesday, March 26 next. The fee for the conference is £2, and further details can be had from the Registrar, College of Technology, Suffolk Street, Birmingham, 1.

Scottish News

There has been a somewhat disturbing expansion of unemployment in Scotland, but little so far in the metal-working and engineering fields. These remain essentially busy, although rather less overtime is being worked than at this time a year ago. The prospects for the industry remain sound, and a considerable number of new projects have been indicated to justify this view. The point must be added that these projects are essentially large-scale and involve the larger units. Smaller concerns are finding development more difficult, and are noticing the impact of credit restraint a factor of importance in their working.

From the Border there is news of considerable progress by Lowlands Leadmines Limited, who are working the old Lowther Hills deposits and are now handling about 1,000 tons of crude ore per week. A new mill has been erected and is providing useful work for an area which has been idle over the long period of disuse.

Parliamentary News

By Our Lobby Correspondent

Copper Wire Exports. — Viscount Elibank asked the Government in the House of Lords whether, in 1957, copper wire was removed from the Board of Trade list of goods subject to embargo or quantitative limitation for China, and, if so, whether they would state on what grounds restrictions were now being imposed on the export of copper wire to China at a time when it was not in short supply.

The Minister Without Portfolio, Lord Mancroft, replied that the Board of Trade's 1957 list was a unified list which brought the controls on trade with China into complete alignment with the controls on trade with the Soviet bloc. Copper wire had not been included because, in relation to the Soviet bloc, our only continuing obligation to our partners in the Paris Group was to watch how that trade was developing. But in view of the way the trade was developing, they had already at that stage applied a limitation to exports to the Soviet bloc; and, following the unification of the controls, that limitation had been extended to China in place of the pre-existing embargo.

Viscount Elibank asked whether Lord Mancroft was aware that if it were a matter of operation under the embargo the exporters of copper wire knew exactly where they were, whereas when, as had happened, the controls were switched to and from, it was quite impossible for them to lay their plans ahead with regard to the total amount needed to export.

Lord Mancroft replied that there were, of course, difficulties, inherent to that system, but several firms had been told last December that applications from them for stated tonnages would be favourably considered if and when they produced evidence that Chinese buyers had given them contracts. No licence for China had, however, so far been granted, as none of those firms had yet reported a Chinese order.

Viscount Elibank asked whether Lord Mancroft had any information which would suggest that Chile was entering the copper wire market.

Lord Mancroft said he had heard rumours that Chile was willing to sell copper wire to the Soviets. They had, however, seen no reports of Chilean interest in supplying China, and, so far as they knew, there had not been any Chilean sale, direct or indirect, of copper or copper wire to the Soviet bloc itself.

Forthcoming Meetings

March 10—Institute of Metals. Scottish Local Section. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2. "Metallurgist in the Chemical Industry." L. Powell. Followed by the Annual General Meeting. 6.30 p.m.

March 10 — North East Metallurgical Society. Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough. "Recent Advances in Metallography." D. McLean. 7.15 p.m.

March 12 — Liverpool Metallurgical Society. Liverpool Engineering Society, 9 The Temple, Dale Street, Liverpool. "Non-Ferrous Tubes in the Stress of Modern Conditions." C. Breckon. 7 p.m.

March 12 — Manchester Metallurgical Society. Manchester Room, The Central Library, Manchester. "Martensitic Transformations." J. W. Christian. 6.30 p.m.

March 12—Institute of Metal Finishing. Organic Finishing Group. Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1. "Catalytic Combustion of Stoving Oven Exhaust." A. Aikens. 6.30 p.m.

Correspondence

Correspondence is invited on any subject considered to be of interest to the non-ferrous metal industry. The Editor accepts no responsibility either for statements made or opinions expressed by correspondents in these columns

Scrap Metal Merchants

To the Editor of Metal Industry

SIR,—You were kind enough some short while ago to give space in your columns to the correspondence concerning prospective amendment of the rules of the National Association of Non-Ferrous Scrap Metal Merchants, of which we are members. This matter culminated in the formation by the National Association, of a Committee of Enquiry, whose duty it was to examine these proposals and make recommendations to the Council of the Association.

Since this Committee has failed in its objective, both by omission and commission, we should be glad if you would afford us the opportunity of elucidating the present position, and presenting our ideas on the matter for the benefit of your interested readership.

It is a regrettable fact that we should not otherwise be able to state our case; nor would members be aware of what transpired at the meeting of the Committee of Enquiry or of the views expressed which led to the resignation of the Council.

We had expected that the deliberations of the meeting would be communicated in full to the members, particularly in view of the Council's resignation, but such was not the case. At the time of our acceptance to serve on the Committee of Enquiry, there was no thought of the Council resigning, nor was this contemplated at any time, and in any event, such an outcome was quite beyond the Committee's terms of reference.

Since the Secretary of the Association has informed members that "with the exception of one member, the whole Council will stand," the re-election of the Council virtually *en bloc* became a foregone conclusion. Judging by past experience, Council members are habitually re-elected when they stand for office. Such has been the common practice hitherto, and since Council members are likely to vote for each other, it is now more likely than ever. In the circumstances, it is most understandable that others have not presented themselves for election; moreover, a large number of members are too indifferent to nominate alternatives, or even to vote. This entire procedure, whose implication is that an organized minority has the power to make decisions affecting the majority of merchants, is, in our view, seriously detrimental when a large number desire reform, and are frustrated by the few.

The position would be clarified if the Council, who will finally have to face the issue of reform, would state clearly whether they will change the rules if a resolution is carried of which it does not wholly approve. Will the Council merely fall back on resignation *en bloc*, or will it abide by the decision of the members, if their wish be contrary to its own? The Council's attitude to this question should be made known to the general body of members.

We wish to state that there was a certain measure of agreement on all points except one, namely, the eligibility of members to serve simultaneously on the Council of the Ingot Makers' Association and on ours. Incidentally, had the Council adopted our suggested reform on this point, this would not have precluded firms from having members on both Associations. Despite our conciliatory attitude and the fact that we have considerably modified our original views on this and other matters raised, the Council has continued to treat the matter as an issue of members' confidence in the Council, which places an entirely false connotation on all the points raised. We would have imagined that this particular point would, in fact, have enjoyed the support of the Council, as it seems more than obvious that the same individual cannot simultaneously represent the true interest of both Associations.

The resignation of the Council was strongly advocated by one member of the Council at the meeting of the Committee of Enquiry, and was not envisaged by us. Our sole object has been, and is, the introduction of reforms which will render the Association a democratic and efficient body well fitted to serve the aims and ends of our industry.

Yours, etc.,

C. C. Bray
(The Wolverhampton Trading and Scrap Co. Ltd.)

W. Knowles
(Britannia Metals)

S. Sternberg
(F. C. Larkinson Ltd.)

To the Editor of Metal Industry

SIR,—You have been kind enough to give me sight of a letter, dated February 28, appearing over the signature of Mr. Sternberg and certain other gentlemen. This letter is so misleading that I feel it calls for an immediate reply. At the December General Meeting of the National Association of Non-Ferrous Scrap Metal Merchants, a resolution was passed, instructing the President to appoint a Committee to enquire into certain proposals that had been put forward for amending the rules of the Association. At a meeting of this Committee on January 22, the proposals were discussed in great detail and it was agreed that the best way of ascertaining the views of the members of the Association on those amendments dealing with the question of eligibility for election to the Council, would be by the whole Council resigning and submitting themselves for re-election; this, it was agreed, would settle beyond all doubt the question of whether or not the Council, as constituted under the present rules, enjoyed the confidence of the Members of the Association. As it was the proposed amendments regarding this particular question which were the only really important points on which the Committee had to give a decision, it is difficult to understand the grounds on which it could be said the Committee failed in its objective.

Members of the Association were fully informed about the points at issue, both from letters they have received from Mr. Sternberg and from communications from the Secretary of the Association. The Council of the Association, by submitting themselves for re-election, gave the Members of the Association every facility to record their views on these issues. To say that the 18 Members of the Council, by voting for each other (which in itself is only an assumption on Mr. Sternberg's part) could outvote all the other Members of the Association, numbering over 300, is too childish to merit any comment. It is difficult to see what more the Council could do to prove their point if Mr. Sternberg was not prepared to put himself up for election on this occasion. He seems to assume that the reason why, in the last two years, the retiring members of the Council were re-elected in preference to him was due to some influence that they exerted over the Members of the Association. Apparently, it has not occurred to him that the reason may simply be that the Association have more confidence in the present Members of the Council than they have in him. While it is true that a large number of the Members of the Association do not exercise their right to vote, one can only be guided by those who do exercise that right. To suggest that the policy of the Association should be based on the assumed wishes of those who are too indifferent to bother to vote, is ludicrous.

The suggestion underlying the query on whether the Council would change the rules if the resolution amending them is carried, is surely mischievous. Mr. Sternberg must be quite well aware that the Council has no power to reject any resolution carried by the Members in a General Meeting, and the object of the question is simply to create a totally erroneous impression that the Association is ruled by a despotic Council, which has no regard to the wishes or interests of the Members. I feel certain that the good sense of the vast majority of the Members makes it unnecessary to use up any more of your valuable space in refuting such an innuendo.

If I may sum up, the Council, in its deliberations on Mr. Sternberg's proposals, has been guided throughout by the desire to serve the best interests of the Association. It is firmly of the opinion that amendments to the rules governing the constitution of the Council, which have been suggested by Mr. Sternberg, would not increase the efficiency of the Association. At the meeting of the Committee (at which Mr. Sternberg was present), set up at the December General Meeting, it was agreed that the best way to elicit the views of the Members of the Association on these amendments would be for the Council to resign and put themselves up for re-election and I certainly assumed that Mr. Sternberg and other people who appeared to support his views would then stand for election. Mr. Sternberg, however, was not prepared to do this, and as a result, he now claims that the resignation and unanimous re-election of the Council proves nothing. The Council, however, can hardly be blamed for this.

Yours, etc.,

for National Association of Non-Ferrous Scrap Metal Merchants

Miles C. Elton
President.

Metal Market News

ON the whole, last week was not a good one for holders of the non-ferrous metals since, without exception, values were marked down and losses were sustained all along the line. As a background, conditions on Wall Street, and, for that matter, on our own stock exchange too, were no help, for on several days prices fell rather sharply and sentiment was adverse. Developments on the industrial front are far from pleasing, and unemployment is still growing, both in the United States and in this country. In the United Kingdom the motor car trade is outstanding in an otherwise slightly gloomy picture and the renewal of activity there is most encouraging. On the Metal Exchange there was rather more activity, and turnovers mostly exceeded those of the previous week. For example, some 8,200 tons of standard copper changed hands, apart from tonnage dealt in on the Kerb, which, at a rough estimate, might have totted up to 500 tons. Early in the week, the American custom smelters' price was reported down to 23½ cents, and on Thursday of last week there was a further reduction to 23 cents, at which level some business was reported. On the same day, the Belgian quotation came down by 50 points to 22½ francs per kilo, so that one way and another the London market had a good deal to contend with. This was reflected in the course of the price movement, for on balance both positions lost £3 15s. 0d., cash closing last Friday afternoon at £160 10s. 0d. and three months at £162. Moreover, the Kerb was weak and three months was traded at £161 10s. 0d. Stocks in L.M.E. warehouses at the beginning of the week were reported 350 tons up at 19,855 tons, the total thus returning to the figure of the previous week.

The cash price of tin fell away in the face of an increase of 790 tons in the L.M.E. stocks, which were reported up to 17,406 tons. During the week some Pool support appeared to be in evidence, for cash was dealt in at £730. Following a fluctuating market in Singapore, prices lost ground here and on balance cash closed £5 10s. 0d. down at £730 10s. 0d., while three months was £2 10s. 0d. lower at £735 10s. 0d. The turnover was about 1,225 tons without Kerb dealing. Interest in tin across the Atlantic appears to have fallen away again but, on the whole, the outlook is rather better than it was some weeks ago, when, for a time, there were fears about the survival of the Tin Buffer Pool Scheme. In this country demand is fairly good, and certainly relatively a good deal better than it is in the States. Opinions continue to differ about the future of tin, but there are still a number of people who believe that we may run into a very tight situation with the bulk of nearby metal in the hands of the Tin Council. From the point of view of anyone desirous of hedging, the £5 contango is certainly attractive.

Contrary to their performance of recent weeks, both lead and zinc showed weakness, partly due to the adverse influence of tin and copper, but also because of the uncertainties of the present situation. In lead there was a turnover of 4,675 tons, both prompt and forward being marked down by £2 10s. 0d. to £73 10s. 0d. and £73 5s. 0d. respectively. Zinc followed a similar course, but while the fall in February was £2 7s. 6d., that in the third month, May, was only £1 7s. 6d., closing quotations being £61 15s. 0d. and £62 10s. 0d., the backwardation of a week earlier becoming a contango of 15s. The uncertainty attaching to the United States duties on zinc and lead still drag on and it must be admitted that, so far as price is concerned, the outlook for these two metals is not particularly good.

New York

Conditions in copper, lead and zinc continued slow during last week, although somewhat better interest was shown in custom smelter copper at 23½ cents a lb. However, this buying activity was only limited and unsustained, and in order to stimulate fabricator buying one leading custom smelter reduced his price to 23⅛ cents a lb. Other custom smelters indicated they would sell at that price too, and 23⅛ became general. However, a number of trade sources believed that the custom smelter price level would soon drop to the more rounded level of 23 cents a lb. The producer copper price continued at 25 cents a lb., but business lagged and trade sources said pressure on the price was increasing in view of the wider spread between the custom smelter and the producer level.

Fabricators reported no improvement in their business and January copper statistics pointed up the depressed state of the industry. The volume of new business booked by brass and wire mills in January, at 57,461 tons, dropped 35,518 tons from December and was the smallest for any month since July, 1949. Copper sources cited the continuing extensive lay-offs in the auto industry — an important customer of brass mills—as one of the depressing factors on that market.

Brass mills trimmed their prices on most shipments ranging from 10,000 to 30,000 lb. For such products as brass and copper strip sheet, and bars and special alloys, buyers of 20,000 to 30,000 lb. will now get the cent a lb. discount on the base price that formerly applied to shipments above 30,000 lb. They had previously been getting a discount of a half-a-cent a lb. The discount on free cutting brass rods in this tonnage bracket was increased to a cent from half-a-cent a lb.

In the lead and zinc industry, further curtailments were reported. St. Joseph Lead announced a cut in output of lead of some 6,000 tons over a one-to-three month period, beginning in March, at its lead mines in south-eastern Missouri. It also announced a cut of a few thousand tons in zinc production, also beginning in March, at its Josephtown, Pennsylvania smelter. Demand for lead and zinc continued slow. Some business was generated by consumer late covering for March needs, but this had little effect on the general lethargic demand.

Tin was more active and firmer, with tin plate buying better than for some weeks. Low inventories, coupled with the firm tone of tin abroad, were cited as the reason for the buying.

Paris

The constant development in the use of aluminium is noted in an official report just published. The report states that between 1953 and 1957 the sale of aluminium in France and within the Franc zone had doubled, passing from 75,000 tons to 150,000 tons. In 1956-57 sales increased by 15 per cent. Exports have had to be limited in order to meet the demands of the French market.

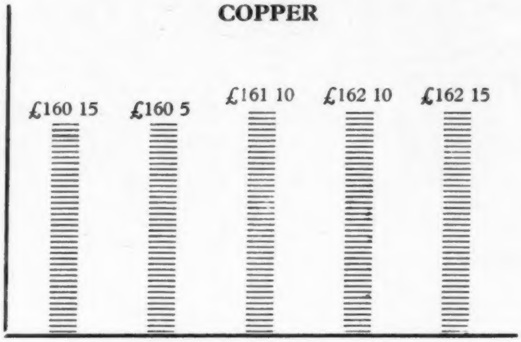
The development is not restricted to one or two industries, such as the transport and electric industries. Packaging, building, and many other industries are now turning to aluminium. Consumption is expected to rise to 180,000 tons. Restrictions on exports will probably continue unless production takes a sudden bound forward.

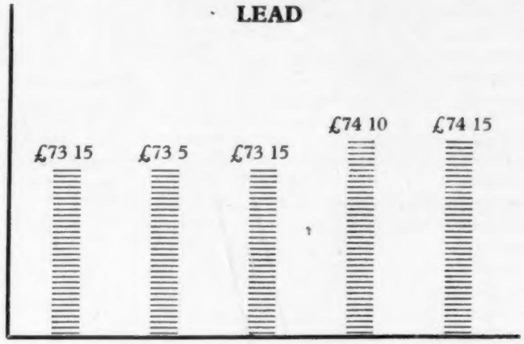
The lead and zinc programme of Penarroya was published this month. Innumerable countries are included in the report. Greece, Iran, Tunisia, etc., are mentioned. Prospecting and research have revealed reserves amounting to at least 5,500,000 tons in France, Italy, Greece, etc. New mines will replace the dwindling reserves, for both metals, in many mines being worked.

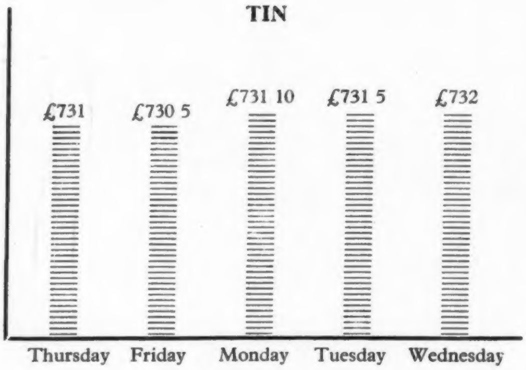
It is also pointed out that the new sources are mostly in Europe and the industry will not depend, to the same extent, on North Africa. Under present conditions this is, of course, of the greatest importance. There will be a general regrouping of the mines, and many marginal ones will be closed. The new flow of metal will, it is believed, also protect Penarroya against the extreme fluctuations in the prices of the two metals.

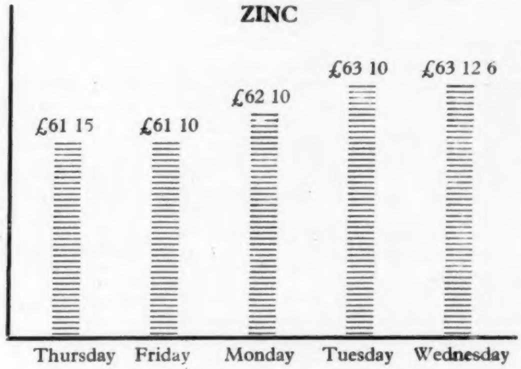
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 27 February 1958 to Wednesday 5 March 1958









OVERSEAS PRICES

Latest avaliable quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium		Canada		France		Italy		Switzerland		United States	
	fr/kg ≏	£/ton	c/lb ≏	£/ton	fr/kg ≏	£/ton	lire/kg ≏	£/ton	fr/kg ≏	£/ton	c/lb ≏	£/ton
Aluminium			24.63	203 10	210	182 15	400	232 0	2.50	209 0	28.10	224 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,400	1,218 0	2,550	1,479 0			155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							340	197 5				
Electrolytic	22.50	164 10	24.50	202 7 6	213	185 7 6			2.00	167 5	25.00	200 0
Lead			12.25	101 2 6	123	107 0	182	105 10	.95	79 10	13.00	104 0
Magnesium												
Nickel			71.50	590 10	1,205	104 17 6	1,330	771 10	7.70	643 17 6	74.00	592 0
Tin	102 25	747 10			895	778 12 6	1,42[illegible]	823 12 6	8.77	733 7 6	94.62	757 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	158	91 12 6	.82	68 10	11.75	94 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 5/3/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	197	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	13	18	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	162	10	0
Fire Refined 99·70%	„	161	0	0
Fire Refined 99·50%	„	160	0	0
Copper Sulphate	„	64	0	0
Germanium	grm.		—	
Gold	oz.	12	9	3½
Indium	„		10	0
Iridium	„	27	0	0
Lanthanum	grm.		15	0
Lead English	ton	74	15	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	77	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	7	10	0
Platinum	„	26	15	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	4¾
Tellurium	lb.		15	0
Tin	ton	732	0	0
Titanium	lb.		19	6
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	63	9	4½
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	88	9	4½
Granulated 99·99+%	„	101	11	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	227	0	0
B.S. 1490 L.M.6	„	217	0	0
B.S. 1490 L.M.7	„	231	0	0
B.S. 1490 L.M.8	„	220	0	0
B.S. 1490 L.M.9	„	218	0	0
B.S. 1490 L.M.10	„	236	0	0
B.S. 1490 L.M.11	„	231	0	0
B.S. 1490 L.M.12	„	240	0	0
B.S. 1490 L.M.13	„	231	0	0
B.S. 1490 L.M.14	„	241	0	0
B.S. 1490 L.M.15	„	227	0	0
B.S. 1490 L.M.16	„	222	0	0
B.S. 1490 L.M.18	„	220	0	0
B.S. 1490 L.M.22	„	228	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	155	0	0
B.S. 1490 L.M.2	„	161	0	0
B.S. 1490 L.M.4	„	183	0	0
B.S. 1490 L.M.6	„	205	0	0

†Average selling prices for January

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton		—	
BSS 1400 AB.2	„		—	
***Brass**				
BSS 1400-B3 65/35	„	124	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)		149	0	0
(86/7/5/2)	„	161	0	0
(88/10/2/1)	„	203	0	0
(88/10/2/½)	„	210	0	0
Manganese Bronze				
BSS 1400 HTB1	„	162	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	230	0	0
Phosphor Copper				
10%	„	198	0	0
15%	„	208	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	412	6	0
Grade D Plumbers	„	281	0	0
Grade M	„	380	0	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	94	16	3
Mazak V	„	98	16	3
Kayem	„	104	16	3
Kayem II	„	110	16	3
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	9
Sheet 18 S.W.G.	„		2	11
Sheet 24 S.W.G.	„		3	2
Strip 10 S.W.G.	„		2	9
Strip 18 S.W.G.	„		2	10
Strip 24 S.W.G.	„		2	11½
Circles 22 S.W.G.	„		3	3
Circles 18 S.W.G.	„		3	2
Circles 12 S.W.G.	„		3	1
Plate as rolled	„		2	8½
Sections	„		3	2¼
Wire 10 S.W.G.	„		3	0
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1¼
Sheet 18 S.W.G.	„		3	4
Sheet 24 S.W.G.	„		3	11¼
Strip 10 S.W.G.	„		3	1¼
Strip 18 S.W.G.	„		3	3
Strip 24 S.W.G.	„		3	11
BS1477 HP30M.				
Plate as rolled			2	11½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	9½
Sheet 18 S.W.G.	„		4	1¼
Sheet 24 S.W.G.	„		4	11¼
Strip 10 S.W.G.	„		3	10¾
Strip 18 S.W.G.	„		4	1¼
Strip 24 S.W.G.	„		4	9
BS1477. HPC15WP.				
Plate heat treated	„		3	6½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0
BS1476. HE10WP.				
Sections	„		3	2
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	4⅛
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	197	0	0
Extruded Bar	lb.		1	7½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	137	0	0
Condenser Plate (Naval Brass)	„	147	0	0
Wire	lb.		2	1⅞
Bronze Sheet and Strip	ton		—	
Copper Tubes	lb.		1	7⅛
Sheet	ton	190	0	0
Strip	„	190	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	209	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	1⅛
Lead Pipes (London)	ton	115	5	0
Sheets (London)	„	113	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Rods	lb.		—	
Sheet and Strip 7%	„		3	2
Wire 10%	„		3	8½
Phosphor Bronze				
Wire	„		3	4⅛
Titanium				
Billet	lb.	4	10	0
Sheet	„	6	12	0
Wire	„	9	10	0
Tube	„	16	0	0
Zinc Sheets, English destinations	ton	97	10	0
Strip	„		nom.	

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 4/3/58.

	£
Aluminium	
New Cuttings	160
Old Rolled	130
Segregated Turnings	100
Brass	
Cuttings	105
Rod Ends	102
Heavy Yellow	85
Light	80
Rolled	95
Collected Scrap	82
Turnings	96
Copper	
Wire	135
Firebox, cut up	135
Heavy	129
Light	124
Cuttings	135
Turnings	118
Braziery	108

	£
Gunmetal	
Gear Wheels	140
Admiralty	140
Commercial	116
Turnings	111
Lead	
Scrap	65/10
Nickel	
Cuttings	—
Anodes	525
Phosphor Bronze	
Scrap	116
Turnings	111
Zinc	
Remelted	—
Cuttings	39
Old Zinc	27

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£143.10.0)	165
Heavy copper	(£143.10.0)	165
Light copper	(£121.17.6)	140
Heavy brass	(£91.7.6)	105
Light brass	(£65.5.0)	75
Soft lead scrap	(£56.10.0)	65
Zinc scrap	(£39.2.6)	45
Used aluminium unsorted	(£82.12.6)	95
France (francs per kilo):		
Copper	(£187.0.0)	215
Heavy copper	(£187.0.0)	215
Light brass	(£134.17.6)	155
Zinc castings	(£64.7.6)	74
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£139.5.0)	160

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£104.10.0)	180
Lead, soft, first quality	(£87.0.0)	150
Lead, battery plates	(£52.5.0)	90
Copper, first grade	(£159.10.0)	275
Copper, second grade	(£148.0.0)	255
Bronze, first quality machinery	(£162.10.0)	280
Bronze, commercial gunmetal	(£133.10.0)	230
Brass, heavy	(£110.5.0)	190
Brass, light	(£98.12.6)	170
Brass, bar turnings	(£113.2.6)	195
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

Financial News

LIGHT METALS STATISTICS IN JAPAN (November, 1957)

Classification	Production	Shipment	Stock	Export
Alumina	13,151	12,827	15,279	0
Aluminium				
Primary	5,735	5,418	3,954	162
Secondary	1,458	1,540	290	0
Rolled Products	4,981	4,995	1,458	533
Electric Wire	1,081	1,177	672	207
Sheet Products	1,402	1,420	—	37
Castings	1,579	—	—	—
Die-Castings	821	—	—	—
Forgings	88	—	—	—
Powder	—	—	—	—
Primary Aluminium (December)	5,454	5,706	3,702	54
Sponge Titanium	117	—	—	132
Magnesium	64	61	9	0
Secondary	157	141	96	0

Titanium Pigment Prices

We are informed by British Titan Products Co. Ltd. that the price schedule of B.T.P. titanium pigments has been revised and the prices of the principal grades reduced. The price reductions vary from grade to grade and the new prices per ton for minimum 10 cwt. lots are as follows:—

Rutiox CR and HD	£178	0	0
Rutiox SM (previously known as Rutile 272)	£168	0	0
Anatase LF and DM	£170	0	0
Anatase E, HR and Granular	£163	0	0
Anatase 70 per cent	£135	0	0
Anatase 50 per cent	£112	0	0
Anatase 25 per cent	£85	0	0

Prices for smaller and larger quantities are available on application.

Evered and Co. Ltd.

Annual accounts show trading profit for the last year at £227,860, against £258,954 in the previous year. Net profit, after taxation, is £120,531 (£134,469). Final dividend of 10 per cent making 15 per cent for the year.

General Refractories Ltd.

Group trading profit for 1957 and other income £1,158,738 (£902,103). Net profit after all charges, including taxation, £382,840 (£300,579). Recommended dividend 20 per cent, against 17½ per cent.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons, Limited, Company Registration Agents, Chancery Lane, W.C.2.

Merridale Pressings Limited (597173), Merridale Works, Wolverhampton. Registered January 15, 1958. To carry on business of presswork manufacturing of all kinds, etc. Nominal capital, £100 in 5s. shares. Directors: C. G. Broome and Mrs. M. Broome.

Phoenix Diecastings (Birmingham) Ltd. (597275), 18 Gough Road, Edgbaston, Birmingham, 15. Registered January 16, 1958. To take over business carried on as "Phoenix Diecasting Co." at Birmingham, etc. Nominal capital, £7,500 in £1 shares. Permanent Directors: R. R. Breakwell, F. Mooney, Kathleen E. Breakwell and Cynthia K. Mooney.

Langford Patents Limited (597304), 31 Bedford Row, W.C.1. Registered January 16, 1958. To acquire patents and rights relating to improvements in metal stampings for aircraft, machine tools and engineering specialities, etc. Nominal capital, £1,000 in £1 shares. Directors: H. Langford and Lorna C. Langford.

Trade Publications

Welding Notes.—Suffolk Iron Foundry (1920) Ltd., Sifbronze Works, Stowmarket, Suffolk.

In the latest issue of this welding quarterly, a number of interesting notes on welding subjects is given, together with an "Any Questions" section and a number of useful illustrations.

Materials Handling and Sintering Plant.—Head Wrightson Iron and Steel Works Engineering Ltd., Teesdale Iron Works, Thornaby-on-Tees.

Details of the various exclusive patented features incorporated in the materials handling and sintering plant designed for this company are described in a twelve-page coloured booklet, together with a number of diagrams and photographs.

Continuous Furnaces.—G.W.B. Furnaces Limited, P.O. Box 4, Dibdale Works, Dudley.

Two new leaflets have been issued dealing with, respectively, roller hearth and pusher type continuous furnaces. The former is an eight-page coloured leaflet describing the application and design features of the roller hearth furnace. The pusher type furnace is described in a triple-fold leaflet, with technical details. Both leaflets include a number of useful illustrations of furnaces in action. Copies of these publications may be obtained on application to the company.

Electronic Controls. — Sciaky Electric Welding Machines Ltd., Falmouth Road (Trading Estate), Slough, Bucks.

A twelve-page coloured brochure deals with the new electronic systems used in connection with this company's electric welding machines. Particulars of the various units are given, together with diagrams and illustrations.

THE STOCK EXCHANGE

Market Remains Quiet But Prices Show Recovery

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 4 MARCH	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	17/9	—9d.	10	10	11 5 3	19/9	17/9	28/3	18/-
400,000	2/-	Anti-Attrition Metal	1/6		8½	7½	11 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	48/9	+1/9	15	15	6 3 0	50/-	47/-	72/3	47/9
1,590,000	1	Birfield Industries	50/-		15	20N	6 0 0	53/9	50/-	70/-	48/9
3,196,667	1	Birmid Industries	56/3	—6d.	17½	17½	6 4 3	57/9	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	24/6	—4½d.	10	8	8 3 3	26/7½	24/6	33/-	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/7½		5	5	6 16 9	15/-	14/7½	16/-	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/10½		6	6	7 2 3	17/-	16/6	19/-	16/6
500,000	1	Bolton (Thos.) & Sons	26/10½	—7½d.	12½	12½	9 6 0	28/9	26/10½	30/3	28/9
300,000	1	Ditto Pref. 5%	15/3		5	5	6 11 3	—		16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/-		7	7	7 7 3	—		22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	44/9	+1/3	12	12	5 7 3	44/9	41/3	72/-	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/-	—3d.	6	6	6 6 3	19/3	18/4½	21/6	18/-
15,000,000	Stk. (£1)	British Insulated Callender's Cables	39/6		12½	12½	6 6 6	42/-	38/10½	55/-	40/-
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord ...	30/6xd	+1/4½	10	10	6 11 3	32/3	29/-	39/-	29/6
600,000	Stk. (5/-)	Canning (W.) & Co.	20/9	+3d.	25	25	6 0 6	20/9	20/1½	24/6	19/3
60,484	1/-	Carr (Chas.)	2/1½		25	25	X8 4 9	2/3	2/-	3/6	2/1½
150,000	2/-	Case (Alfred) & Co. Ltd.	4/4½		25	25	11 8 6	4/9	4/4½	4/6	4/-
555,000	1	Clifford (Chas.) Ltd.	16/3	+3d.	10	15N	12 6 3	16/6	16/-	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/10½		6	6	7 11 3	—		17/6	16/-
250,000	2/-	Coley Metals	3/6		25	25	14 5 9	4/6	3/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	44/-	—1/-	22½	22½	10 4 6	51/6	43/-	92/6	49/-
1,136,233	1	Davy & United	46/3	—1/3	15	12½	6 6 3	48/-	46/3	60/6	42/6
2,750,000	5/-	Delta Metal	19/9	+1½d.	*17½	*17½	4 8 6	21/4½	19/7½	28/6	19/-
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	24/-	—6d.	15B	22½	10 8 3	26/6	24/-	38/6	25/-
500,000	1	Evered & Co.	40/-	—6d.	15	15	7 10 0	41/3	40/-	52/9	42/-
18,000,000	Stk. (£1)	General Electric Co.	30/6xd	+9d.	12½	14	Y7 10 9	38/7½	30/1½	59/-	38/-
1,250,000	Stk. (10/-)	General Refractories Ltd.	29/3	+1/3	20	17½	6 16 9	29/3	27/3	37/-	26/9
401,240	1	Gibbons (Dudley) Ltd.	66/3	+1/3	15	12	4 10 9	66/3	64/-	71/-	53/-
750,000	5/-	Glacier Metal Co. Ltd.	5/9		11½	11½	10 0 0	6/-	5/7½	8/1½	5/10½
1,750,000	5/-	Glynwed Tubes	13/4½	—1½d.	20	20	7 9 6	13/6	12/10½	18/-	12/6
3,614,032	10/-	Goodlass Wall & Lead Industries ...	28/-	—6d.	18	16	6 8 6	29/9	28/-	37/3	28/9
342,195	1	Greenwood & Batley	46/10½		17½	17½	7 9 3	—		50/-	46/-
396,000	5/-	Harrison (B'ham) Ord.	11/6		*15	*30‡	6 10 6	—		16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9		7	7	7 9 3	—		22/3	18/7½
1,075,167	5/-	Heenan Group	7/-xd		10	20‡	7 2 9	7/7½	6/9	10/4½	6/9
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	38/6	+2/-	10	10	5 4 0	39/10½	36/6	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/6		5	5	6 1 3	17/1½	16/-	18/6	15/6
14,584,025	**	International Nickel	138		$3.75	$3.75	4 17 0	144	136½	222	130
430,000	5/-	Jenks (E. P.), Ltd.	15/3		27½ ϕ	27½	9 0 6	15/7½	14/6	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/-		5	5	6 13 3	—		17/-	14/6
3,987,435	1	Ditto Ord.	37/6		10	9	5 6 9	41/3	37/6	58/9	40/-
600,000	10/-	Keith, Blackman	16/3		15	15	9 4 6	16/3	15/-	21/9	15/-
160,000	4/-	London Aluminium	3/9	+3d.	10	5	10 13 3	4/3	3/6	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord....	39/9	—3d.	12½	12½	6 5 9	41/9	39/9	54/6	41/-
400,000	1	Ditto Pref.	22/9		7½	7½	6 11 9	—		25/3	21/9
765,012	1	McKechnie Brothers Ord.	35/-		15	15	8 11 6	—		48/9	37/6
1,530,024	1	Ditto A Ord.	32/6		15	15	9 4 6	—		47/6	36/-
1,108,268	5/-	Manganese Bronze & Brass	9/-		27½‡	25	7 12 3	9/6	9/-	21/10½	7/6
50,628	6/-	Ditto (7½% N.C. Pref.)	5/9		7½	7½	7 16 6	—		6/6	5/-
13,098,855	Stk. (£1)	Metal Box	42/1½	+4½d.	20‡	15M	4 15 0	43/9	41/9	59/-	40/3
415,760	Stk. (2/-)	Metal Traders	6/3		50	50	16 0 0	6/6	6/3	8/-	6/3
160,000	1	Mint (The) Birmingham	22/-		10	10	9 1 9	22/9	22/-	25/-	21/6
80,000	5	Ditto Pref. 6%	83/6		6	6	7 3 9	—		90/6	83/6
3,064,930	Stk. (£1)	Morgan Crucible A	34/-		10	11	5 17 9	36/6	34/-	54/-	35/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/3		5½	5½	6 7 6	17/3	17/-	19/3	16/-
2,200,000	Stk. (£1)	Murex	53/9	—1/-	20	20	7 8 9	57/6	53/9	79/9	57/-
468,000	5/-	Ratcliffs (Great Bridge)	7/1½		10	10	7 0 3	7/1½	6/10½	8/-	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	27/-		27½D	27½	6 15 9	27/-	26/-	41/-	24/9
1,365,000	Stk. (5/-)	Serck Radiators	11/-		17½Z	15	5 6 0	12/-	11/-	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	43/9		16	16	7 6 6	—		57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	20/-		6½	6½	6 10 0	—		21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	50/-	+1/7½	15	15	6 0 0	53/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	30/1½	+6d.	10	10	6 12 9	31/-	29/4½	46/-	29/-
750,000	Stk. (£1)	Ditto Pref. 5%	15/6		5	5	6 9 0	15/6	14/9	18/-	14/-
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/6	—6d.	*5	*5	6 17 0A	23/-	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	72/9	+9d.	20	15	5 10 0	73/6	70/9	83/-	64/-
2,666,034	Stk. (£1)	Westinghouse Brake	35/3	—3d.	10	18P	5 13 6	36/3	32/6	85/-	29/1½
225,000	2/-	Wolverhampton Die-Casting ...	7/6	+3d.	25	40	6 13 3	7/9	7/2½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	15/3		27½	27½	9 0 3	15/6	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/4½	—1½d.	20	17½E	14 16 3	3/9¾	3/6	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	—		12/6	11/3
150,000	1/-	Zinc Alloy Rust Proof	2/10½		40D	33⅓	9 5 6	3/1½	2/7½	5/-	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. H and 200% capitalized issue. M and 10% capitalized issue. Y Calculated on 11¼% dividend. ||Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share or £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And proposed 100% capitalized issue. X Calculated on 17½%.